AMERICAN ENGINEER CAR BUILDER AND RAILROAD JOURNAL.

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CONTENTS.

The Wheeling & Lake Erie is in the market for from 200 to 500 box cars.

The Chicago & Great Western is said to be in the market for 200 furniture cars.

The Chicago Great Western road will soon give orders for several hundred freight cars.

The Baldwin Locomotive Works have an order for 60 additional locomotives for Russia.

The Lehigh Valley has let a contract to the Michigan-Peninsular Car Company for 1,000 box cars.

The Seaboard Air Line is said to have ordered 12 locomotives from the Pittsburgh Locomotive Works.

The Wells & French Car company has received an order from the Pennsylvania Railroad for 100 hopper-bottom cars.

The New Orleans & Northeastern has given an order for two locomotives to the Richmond Locomotive & Machine Works.

Haskell & Barker, of Michigan City, Ind., are reported to have an order for 150 furniture cars from the Chicago & Northwestern.

The Wisconsin & Michigan Railroad has awarded a contract for 250 box cars to the Missouri Car & Foundry Company, St. Louis.

The Richmond Locomotive and Machine Works has secured an order from Albert Waycott & Co., of St. Louis, for two 55-ton engines.

The Michigan Central road, it is reported, will soon place an order for a large number of freight cars. It is also said to be in the market for about 40 locomotives.

The Delaware, Lackawanna & Western, which recently placed an order with Jackson & Woodin for 1,000 cars, will soon be in the market for an additional 1,000 cars.

The receivers of the Philadelphia & Reading have applied to the United States Court for authority to order 1,000 additional coal cars, 25 refrigerator cars, 250 gondolas and 250 box cars.

The Philadelphia & Reading has placed a contract for 16 coaches with the Pullman Car Company. These cars will be used between Philadelphia and Atlantic City, and will be equipped with Pintch gas and steam heat.

The Grand Rapids & Indiana has placed orders with the Pullman Palace Car Company for three coaches and three combination passenger and baggage cars. The specifications call for the coaches to be 60 ft. long and to seat 70 people.

essrs. Cramp, the well-known shipbuilders, of Philadelphia, have purchased the patent rights of the Yarrow water-tube boiler, and are urging the United States Government to adopt this steam generator in some of the vessels now under construction.

A premium of £50 is being offered by the Verein Deutscher Ingenieure for the best critical paper, in German, on the development of steam engine construction in all industrial countries during the past 50 years. All papers are to be sent in by Dec. 31, 1898.

Messrs. James Howden & Company, of Glasgow, have in the year just closed entered into contracts for the application of their forced-draught system at home and abroad to no fewer than 105 large steamships having an aggregate of 278,500 I. H. P., among which are vessels equal in size and power to the largest steamships afloat.

The statement has been made that the Pullman Palace Car Company is operating one of the departments of its works at Pullman by means of compressed air. This is not the case, but the company has in contemplation the use of compressed air to a limited extent and by way of experiment. The whole matter is as yet undecided.

President Caldwell, of the Lake Shore, is credited with saying that thus far his road has been a gainer by the construction of suburban electric roads. While these roads may have cut into the local passenger business they have on the other hand proved good feeders, and have brought long-distance passenger traffic to the road from points not on its line.

During the last fiscal year of the government there were exported from the United States a total of 1,934 passenger and freight cars for steam roads, and their value is placed at $868,378. Of these 103 went over the Canadian border, 267 to Mexico, 123 to Central America, 4 to the West Indies, 316 to Brazil, 113 to Argentina, and 27 to Venezuela, besides several small orders to other South American countries and a very few to Europe.

It is expected that the contracts for the 5,000 cars to be built for the Baltimore & Ohio Railroad will be given out before the first of the month, but at our time of going to press the result has not been announced. The company invited bids on 5,000 cars, 1,800 of which are box, 1,800 solid bottom coal, 400 drop bottom coal and 1,000 drop bottom coal with coke racks. It is rumored that instead of 75 new locomotives the company will purchase 100.

The process of cold riveting has been largely adopted in Europe in the construction of vessels of light scantlings, such as torpedo-boats and torpedo-boat destroyers. In this connection an interesting series of experiments has been recently carried out to determine the pressure necessary for successfully closing up cold rivets. The results are said to have conclusively demonstrated that a pressure of at least 30,000 pounds per square inch of rivet section was required. We would have thought that even higher pressures would be required.

A double-track extension about three-fifths of a mile long is being built by the Liverpool Overhead Electric Railway. For 850 feet the tracks are on a viaduct and then they enter a tunnel 2,400 feet long. The chief feature of interest about the tunnel is that it crosses the tunnel of the Cheshire Lines Railway, there being only three feet between the two. To prevent an additional weight being put on the lower tunnel, a relieving arch is being built immediately over it, upon which will be constructed the side walls of the upper tunnel.

It is stated that the Northern Pacific Railroad contemplates doing more sluicing along the main line in the Cascade Mountains this season than ever before. Twice as many men will be worked and seven bridges located between Easton and Weston will be filled beneath. These bridges run from 50 to 80 feet in height, and are 400 to 500 feet in length. Work will begin in the middle of April and continue as long as water for sluicing is obtainable in the mountains. Gradually all the trestles and small bridges along the entire line are being filled under solid.

Work has been begun upon the electric road between Baltimore and Washington. The grading of the roadbed at both ends of the line is now being carried out. It is proposed to run the cars on this line at a speed of 60 miles an hour, and the tracks are to be built of the heaviest steel rails. The power plant for the road has been contracted for with the Westinghouse Electric Company, there being two power stations, one located about 10 miles from the Baltimore terminal and the other 10 miles from the Washington terminal. The initial power equipment contracted for is equal to about 6,000 horse power.—*Iron Age.*

According to *The Engineer* Messrs. Thornycroft & Company have succeeded in producing a vessel which is not only the fastest vessel in the world, but has attained that position almost at her first effort. It is well known that as a rule fast vessels are worked up by degrees to their maximum speed, small alterations being usually required in the fitting of the valves, amount of grate, trim of boat, area of propeller, etc. But the *Desperate*, torpedo boat destroyer, designed and built by Messrs. J. Thornycroft & Company, ran a preliminary trial, and obtained a mean speed, on four runs on the measured mile, of 31.035 knots, or 35¾ statute miles. The speed was taken by Admiralty officials, and is the highest on record.

The Technical Club, recently organized by the members of the engineering professions in Chicago, will establish its headquarters at 228–230 South Clark street. This location is directly opposite the post-office, and near the large office buildings in which so many engineers are located, and is convenient in every respect. The club will occupy three floors of the building, and the rooms will be remodelled to suit its requirements. Library, assembly, lounging and billiard rooms will be provided, also public and private dining-rooms, and rooms for the use of technical societies. The quarters will be heated by steam and lighted by electricity. Mr. Robt. W. Hunt is President of the club, Mr. Chas. E. Billin, secretary, and Mr. H. F. J. Porter, Treasurer.

Some months ago, H. M. S. *Penguin*, Commander A. F. Balfour, R. N., found in the Pacific Ocean deeper water than any yet known in latitude 23.40 S., longitude 175.10 W., but had failed to determine the exact depth owing to breakage of the wire at 4,900 fathoms. Captain Balfour has since been enabled to try again, and has announced three satisfactory soundings of over 5,000 fathoms. The deepest trustworthy sounding heretofore known is 4,655 fathoms, near Japan, obtained by the U. S. S. *Tuscarora* in 1874. The deepest of the *Penguin's* casts is 5,155 fathoms, or 500 fathoms (3,000 feet) deeper; but it is especially remarkable that the three casts now obtained are not in the same hollow, but are separated by areas of considerably less water, the two extreme soundings being 450 miles apart.

The locomotive tires in use on the Great Eastern Railway are made of Bessemer steel, having a tensile strength of 40 tons per square inch, and the following composition: Combined carbon 0.350 per cent.; silicon, 0.083 per cent.; sulphur, 0.064 per cent.; phosphorus, 0.047 per cent.; manganese, 0.605 per cent.; iron—by differences—98.851 per cent. The wear on the tires of some six-wheeled coupled suburban engines in severe service was such that only 2,197 miles was obtained per 1/32-inch reduction in thickness, the tires being 4 feet in diameter. Consequently seventeen of these engines were fitted in January, 1892, with special hard-steel tires, having a tensile strength of 48 tons to the square inch, and the results obtained up to their first turning were satisfactory. The average mileage was 47,134 for an amount of wear equal to ¼-in. in thickness, or 5,892 miles per 1/32-inch reduction.

From a report by the Belgian Vice-Consul at Yokohama, it is learned that railway construction in Japan was interrupted by the war with China, but again great activity is being displayed. A sum of 25,000,000 yen (about $12,500,000) has been voted for the construction of a double line from Tokyo to Kobe. This line is 376 miles long and passes through the commercial and industrial centers of Japan, Yokohama, Kyoto, Osuka and Kobe. A quarter of a century ago there was not a single mile of railway in Japan. Official figures state that in March, 1895, there were in the country twenty-nine railway companies which had obtained concessions, and 1,549 miles had been opened for traffic. The state railways comprised 580 miles of line completed and 398 miles in course of construction, and for which funds had been voted.

Prof. Weighton, of the Durham College of Science (England), who has made some tests to determine the best angles for the heads of countersunk rivets for ships plates, says: Assuming the specimens were all good representatives of a class, I am inclined to draw the following deductions, viz.: First, for ¾ inch plates the countersunk should not be less than 56 degrees, and even a greater angle would seem to be not amiss. Second, for ½-inch plates the countersink should not be less than 35 degrees. For other thicknesses the angle of countersink would be in proportion, and therefore, third, the following would be about the angles proper for the different thicknesses:

¾-inch	plate,	56	degrees	angle	of countersink.
⅝	"	45	"	"	"
½	"	35	"	"	"
⅜	"	26	"	"	"

Mr. F. W. Webb, Locomotive Superintendent of the London & North Western Railway, has followed closely the development of electric traction for railway work in America, and he has evidently great faith in the feasibility of working main line traffic by this method. Speaking recently at the Crewe Mechanics' Institute he declared that the time might come when trains would run daily from London to Carlisle—300 miles—without stopping. In fact, he said he was prepared to run trains from Euston to Aberdeen without a stop, and guarantee punctuality on arrival. He was prepared also to run trains by electricity, and he predicted that within a few years electric trains would be run to all the great centers at a speed that it was now difficult to realize. Those who have visited the Crewe works will recall the extensive use that has been made of electricity in manufacturing operations, and will be quite prepared to believe that Mr. Webb has good grounds for these somewhat startling declarations.—*Railway World.*

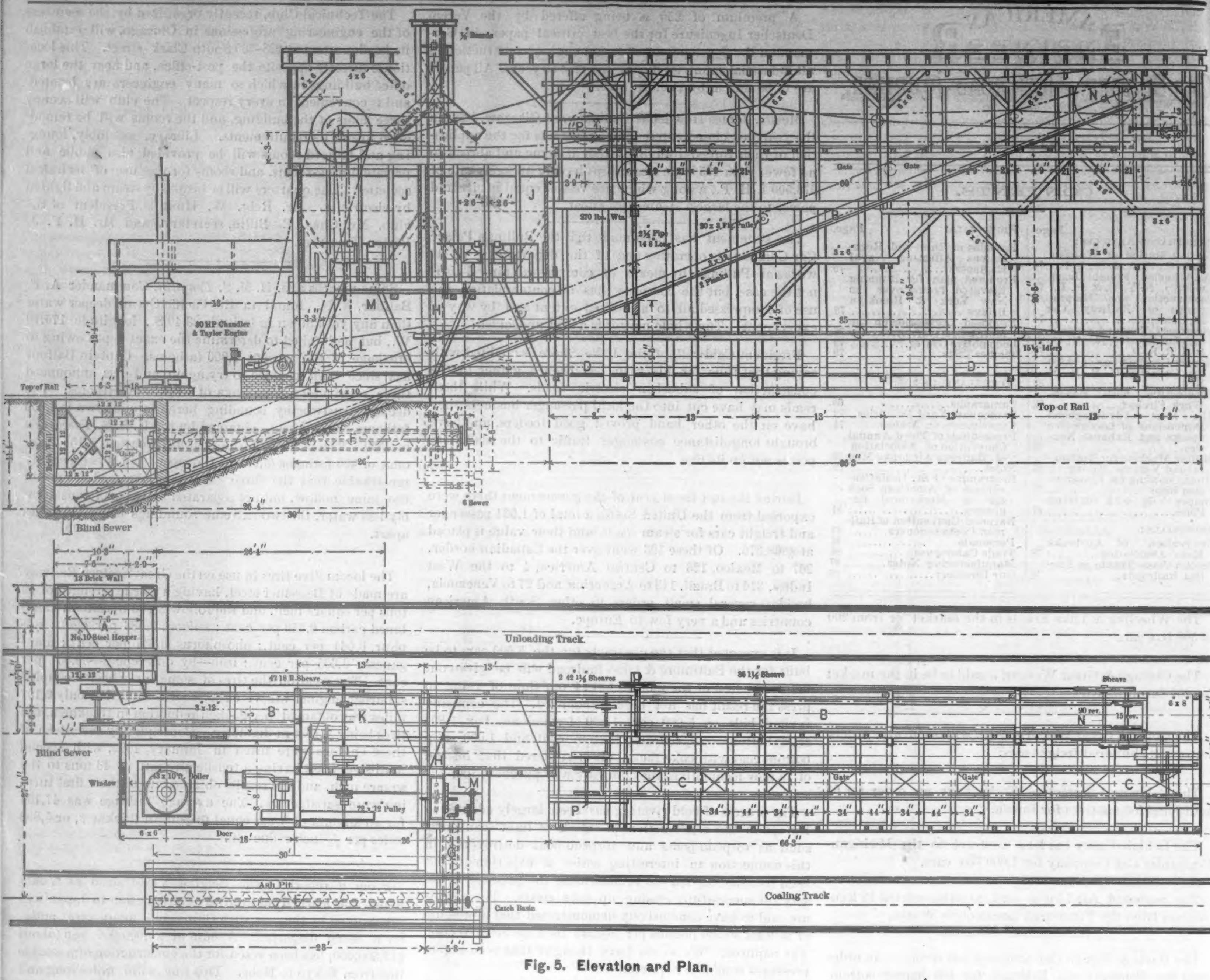


Fig. 5. Elevation and Plan.

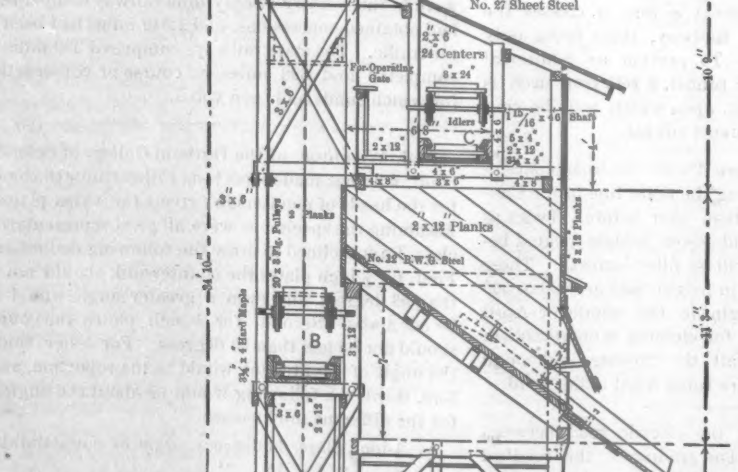


Fig. 6.

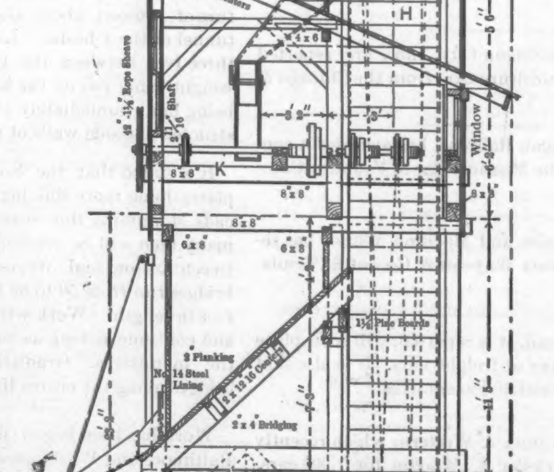


Fig. 7

WABASH COALING STATION.—CLEVELAND, CINCINNATI CHICAGO AND ST. LOUIS RAILWAY.

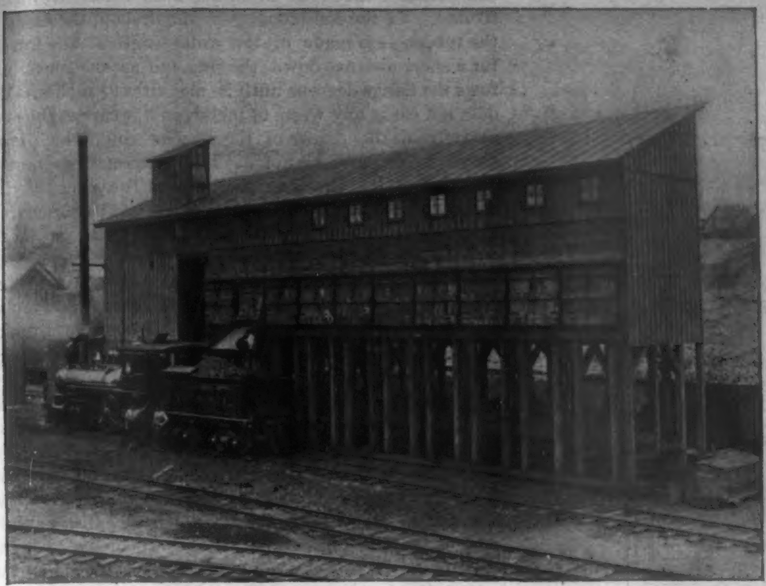


Fig. 1. Front View of Coaling Station.

Fig. 2. Rear View of Coaling Station.

Fig. 3. Pocket Conveyor.

Fig. 4. Shoveling Conveyor.

VIEWS OF COALING STATION AT WABASH, IND.—CLEVELAND, CINCINNATI, CHICAGO & ST. LOUIS RY.

Coaling Station at Wabash.—Cleveland, Cincinnati, Chicago & St. Louis Railway.

At the new shops of the Cleveland, Cincinnati, Chicago & St. Louis Railway at Wabash, Ind., the company has installed an interesting locomotive coaling station. It is one of the very few plants constructed in this country for locomotives in which the coal and ashes are both handled by conveyors. Through the kindness of Mr. Wm. Garstang, Superintendent of Motive Power, we have had the privilege of inspecting the plant, and from him we had received the drawings and photographs from which the accompanying illustrations were made.

The chute contains ten coal and two ash pockets, and stands between two tracks, one of which is for the locomotives when being coaled, and the other for cars bringing coal to the chute or carrying away ashes. Of our four half-tone illustrations, Fig. 1 is a view of the side toward the coaling track, showing a locomotive taking coal, while behind the structure are a number of coal cars on the unloading track; though it does not show very clearly, there is an ash pit under the engine, and extending for some distance in front of it; Fig. 2 is a view from the other side, showing the two ash pockets and some of the conveying machinery; Figs. 3 and 4 are interior views showing the pocket and shoveling conveyors respectively. Figs. 5, 6 and 7 are from the working drawings, and show the arrangement of the machinery.

The building is 92 feet 3 inches long and 14 feet wide, with a low extension 18 feet long at one end, in which is placed the engine and boiler. Coal is received in hopper or flat bottom cars on the unloading track. If the cars have hoppers they unload directly into the steel hopper *A* located in the pit between the rails and clearly seen in both views of Fig. 5 and also in Fig. 6. From thence it is delivered through a gate onto the inclined conveyor *B B* which carries it to the top of the building and to the right hand end of it as seen in Fig. 5. There it is dumped onto an inclined chute which delivers the coal to the horizontal conveyor *C*, which passes over the pockets. Over every pocket there is a gate in the trough of the conveyer as seen in the plan view of Fig. 5. Each gate is opened and closed by a rack and pinion operated by the hand wheels seen in Figs. 3 and 7. When a gate is closed the coal is conveyed over it and beyond to the first open gate, through which it drops into the pocket. Battens on the sides of each pocket indicate the height to which they must be filled for two tons, three tons, etc. From the pockets the coal is, of course, delivered to the locomotive in the usual manner.

Should the coal arrive in flat bottom cars it is then necessary to shovel the coal out of them. Provision has been made for this by providing another horizontal conveyor *D D*, shown in section in Fig. 7. It is also to be seen in Fig. 4, and a glimpse of it is obtained between the posts in Fig. 1. Onto this conveyor the coal falls after it is shoveled out of the car on to the inclined planking shown (Fig. 7). It is by this conveyor taken to the left, in Fig. 4, and delivered through the short chute *E* on to the inclined conveyor *B B*, whence its travels are the same as in the previous case. Of course the coal is transported to the chute in hopper cars where possible, as then there is no shoveling whatever, and no hand labor of any kind.

The manner of handling the ash is equally interesting. An ash pit 28 feet long is located between the rails in front of the engine and boiler house. The bottom of the pit consists of cast-iron gratings made in short sections. Under these there is a screw conveyor running the whole length of the pit and delivering the ash to another screw conveyor placed at right angles to it. This in turn carries the ash into the boot of the elevator *H H*, which takes it to the top of the building and, by means of two aprons, delivers it into the two ash pockets. When the locomotive ashpans are emptied into the pit the plates forming the bottom of the latter are in place, of course, and when the ash accumulates, the conveyor is started up, the plates removed one by one, so as to feed the ash into the conveyor with regularity, and the process goes on, as already described, until the pit is empty. The plates are then put back and the pit is again ready for use.

When the two ash bins are full, a car is run in on the coal unloading track and the ash delivered to it in exactly the same way as an engine takes coal. It will be noticed that the pockets have iron aprons, but the latter are not balanced. Thus the ash is shipped away without any manual labor whatever.

We have described the manner in which the materials are handled, and would now direct attention to the driving mechanism. The small boiler house at the end of the structure contains a 30 horse-power engine and boiler. The boiler is not used at present, however, as steam is taken from the shop boiler. By means of a belt the engine drives the shaft *K*, almost directly above it. From this shaft there is a cable drive to the shaft *N* at the other end of the building, for operating the inclined conveyor. A chain belt to the shaft *P* drives the horizontal conveyor *C C* over the pockets, and another chain belt from the same shaft *K*, to the shaft *L* drives the shoveling conveyor; still another, with a quarter-turn in it, leading to the shaft *M* drives the ash elevator and screw conveyor. Similar reference letters in the different figures refer to the same objects, and our readers will find no difficulty in tracing out the various driving mechanisms.

The plant was built for the company by the Link Belt Machinery Company, of Chicago, and the details of the conveyors and other apparatus all conform to their well-known and successful designs. The plant has been in operation for some months, and has given perfect satisfaction. Mr. Garstang informs us that as far as its machinery is concerned, the plant could coal nearly 100 engines a day. The coal conveyors will place a carload of coal into the pockets in a very few minutes, and the ash is also handled with dispatch. By means of suitable clutches, the ash and coal conveyor can be operated together or either one alone, the engine having power enough to keep everything moving at once. Three men are required about the plant when it is in full operation, but it does its work so rapidly that these men do not give their entire time to it, but are assigned other duties. The cost of the plant was hardly any more than would have had to be expended for an ordinary coaling station with a trestle, an ash pit, depressed tracks, etc. This station also occupies less space than any stations of the same capacity having one track on a trestle and another depressed, and this is an important consideration in many cases.

The plant is an excellent illustration of what can be done in reducing the cost of handling coal and ash with a comparatively small outlay, and its compactness and large capacity, the reduction of labor and the general excellence of the design, should induce railroads to look upon such machinery with greater favor. It is pretty safe to say that the item of labor in coaling locomotives and disposing of their ash is much greater than is generally believed, and that the subject does not receive the attention it deserves. At large terminals, or points where many engines are coaled daily, conveyors have been introduced, but we think that few, if any, conveyors have been installed at coaling stations of moderate size, excepting the Wabash plant. But the small stations are the more numerous and should receive attention. A large economy over present practice can be effected, and the plant we have described is an excellent example of how it can be done.

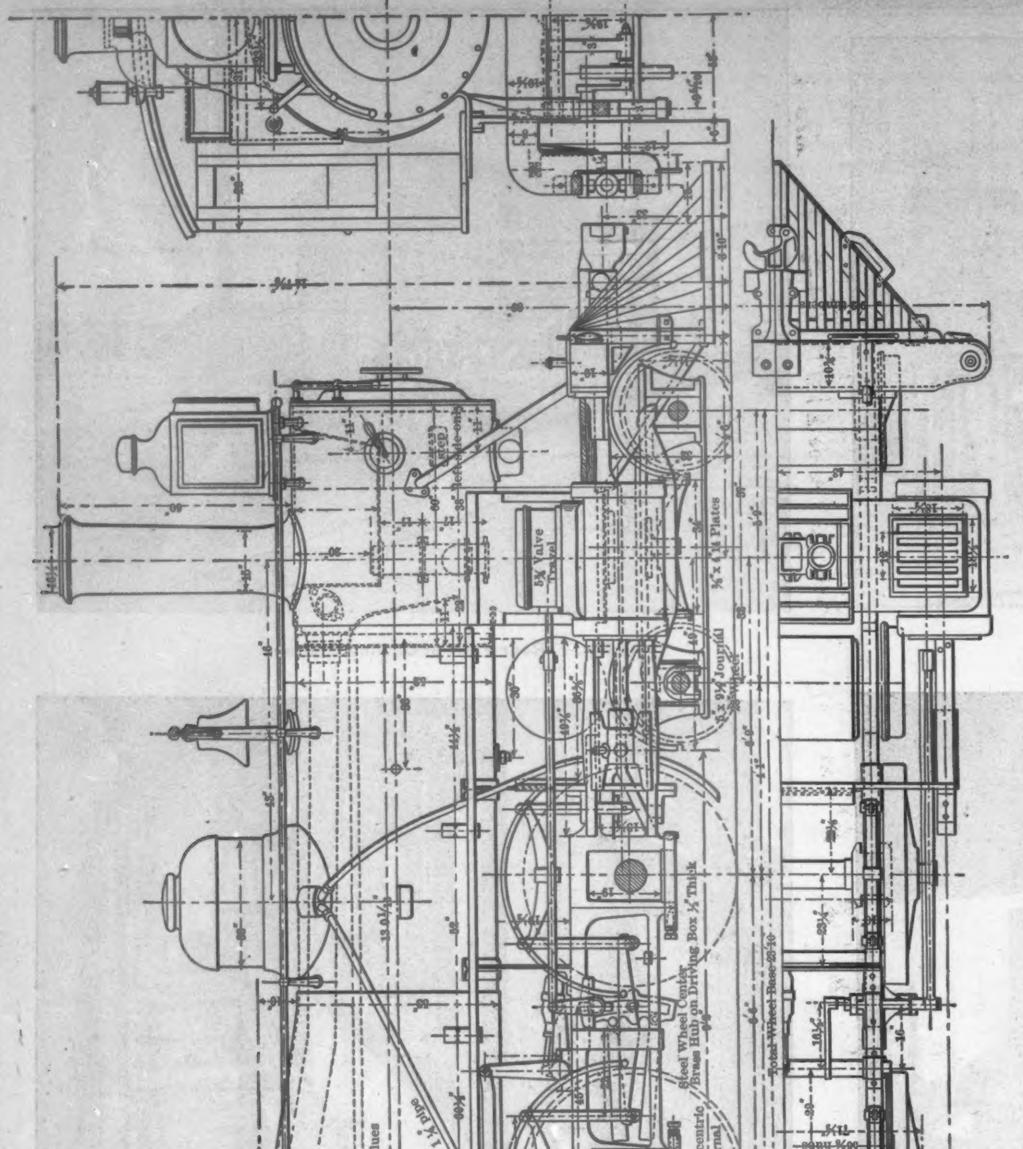


Fig. 1. Ten-Wheeled Freight Locomotive.—New York, Chicago & St. Louis Ry.

Ten-Wheeled Locomotive—New York, Chicago & St. Louis Railway.

The New York, Chicago & St. Louis Railway has recently put in service ten new 10-wheeled freight engines, five of which were built by Brooks Locomotive Works, and the remaining five by the Schenectady Works. Through the courtesy of Mr. John McKenzie, Superintendent of Motive Power, we publish the accompanying illustrations of them.

The engine has 18 by 24 cylinders, which in some sections of the country would not be considered large, but as the divisions of the road on which these engines operate have no grades heavier than 40 feet to the mile, and only a few as steep as that, this size of cylinder is found large enough to haul a train of 43 cars in all ordinary weather and one of the engines is stated to have handled a train of over 1,200 tons on this grade.

The engines have rigid center trucks, and the plain tires are placed on the forward pair of drivers. The links are back of the forward axle and neither long eccentric rods nor intermediate rockers are employed. A respectable radius of link, 45 inches, is obtained and the whole link motion is as free of objectionable features as in an ordinary eight-wheeled engine.

The boiler, shown in Fig. 2, is of the wagon top style and 52 inches in diameter at the first course. The crown is stayed with crown bars, and the firebox is between the frames and over the rear driving axle. The boiler is of substantial construction throughout, and some of its details are uncommon. The longitudinal seams are butted with inside and outside welts. The circumferential seams are double riveted. In the construction of the firebox, the flange of the tubesheet is made of the usual length at the top and for a short distance down the side, but as the sheet narrows the flange deepens until it measures 9½ inches. This does not cause any waste of metal, and it carries the seam away from the corner of the firebox ring, which is believed to be an advantage. It is expected to prevent cracking of the sheets at the seams. The ring has drop corners and is machined inside and out at the corners. It is "set in" one inch opposite the driving boxes, but its full width of 3 inches is maintained. The water space of 4 inches at front is straight, but the back and side spaces enlarge toward the top, those at the sides becoming 7¼ inches. This is believed to be the best possible preventive of broken staybolts. The crownsheet is not arched, but is given a flat slope on each side of the center.

The crown is supported by bars 5 inches by ¾ inch, and from each of these there are two sling stays to the shell. Their upper ends are attached to long tee irons made out of two sheets bent into the form of angles, and extending from near the back head to the dome, with a short section ahead of the dome also. All stays, whether they go to the shell or the dome, have a pin joint in them just above the crown bar. The back head and front tubesheet are supported by gusset stays. The wide water spaces at the sides of the firebox have necessitated two additional stays on each side below the crown, as shown.

The thimbles for the crown-bar bolts are of cast steel, and are not of the conical form so usual in American practice. From the detail shown in Fig. 3 it will be seen that they are cylindrical, one-fourth of an inch thick, and have a rectangular flange at the top end, on which the crown bars have contact. A small projection fits between the bars and prevents the thimble from turning.

The dome is secured to the shell by a solid ring ¾ inch thick and flanged upward for the dome sheet. It measures 6¼ inches by 4¼ inches by ¾ inches in section. The firebrick in the firebox is supported upon 2¼-inch water tubes. The heating surface of the arch tubes is 10 square feet, the

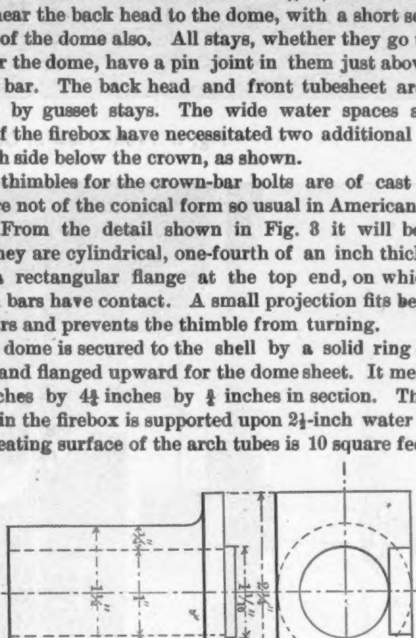


Fig. 3.—Crown Bolt Thimble.

firebox is 145 square feet, and tubes 1,360 square feet, giving a total of 1,515 square feet, while the grate area is 22.4 square feet.

In looking over the elevations in Fig. 1 the reader will notice that most of the details conform to common practice. One departure might be mentioned. The pedestals in the main frames for the rear and front drivers are perfectly straight and two shoes are used instead of the one shoe and one wedge per pedestal, which has been the almost universal practice for years. This arrangement by which a ready adjustment for wear at the driving boxes is deliberately dispensed with, is meeting with favor among those whose observation has led them to conclude that more trouble is caused by unwise adjustment than can arise from the lack of any take-up. The main pedestal has the old form of shoe and wedge, evidently provided for fear of pounding at the main journals.

It is customary to close the bottom of the pedestal with a thimble and bolt or a cap, but in these engines their place is taken by a stirrup or strap, which passes outside and around the lower ends of the jaws and is tightened by a large screw bearing on a gib notched into the outside of the jaw to keep it in place. A similar gib at the other end notched into the frame in the same way gives an additional safeguard against the strap slipping out of place This arrangement is very neat, and has the advantage over the thimble and bolt of not cutting into the frame, while at the same time there is no limit to the strength of the strap; it should be cheaper than a well-fitted cap, and it appears to be easier to remove and put on than either cap or thimble and bolt.

The crosshead is of cast steel and symmetrical with relation to the piston rod. It is a form that many are adopting in place of the Laird type, which by its unsymmetrical form is believed to be the cause of many broken piston rods.

The link motion shown in Figs. 4 and 5 is worthy of attention. All bearings are very large. The link itself is 3 inches wide, and the block is 7 inches long. These substantial proportions are carried into all the details. But perhaps the most interesting feature is the means provided for oiling the various surfaces. Ordinarily most of the surfaces of the link motion are only supplied with oil through a small oil hole each time the engineer goes around with his long snouted oil can, but these engines are expected to haul trains long distances without making stops long enough to permit oiling, and the link motion has been provided with little oil reservoirs in connection with every surface requiring oil. These reservoirs

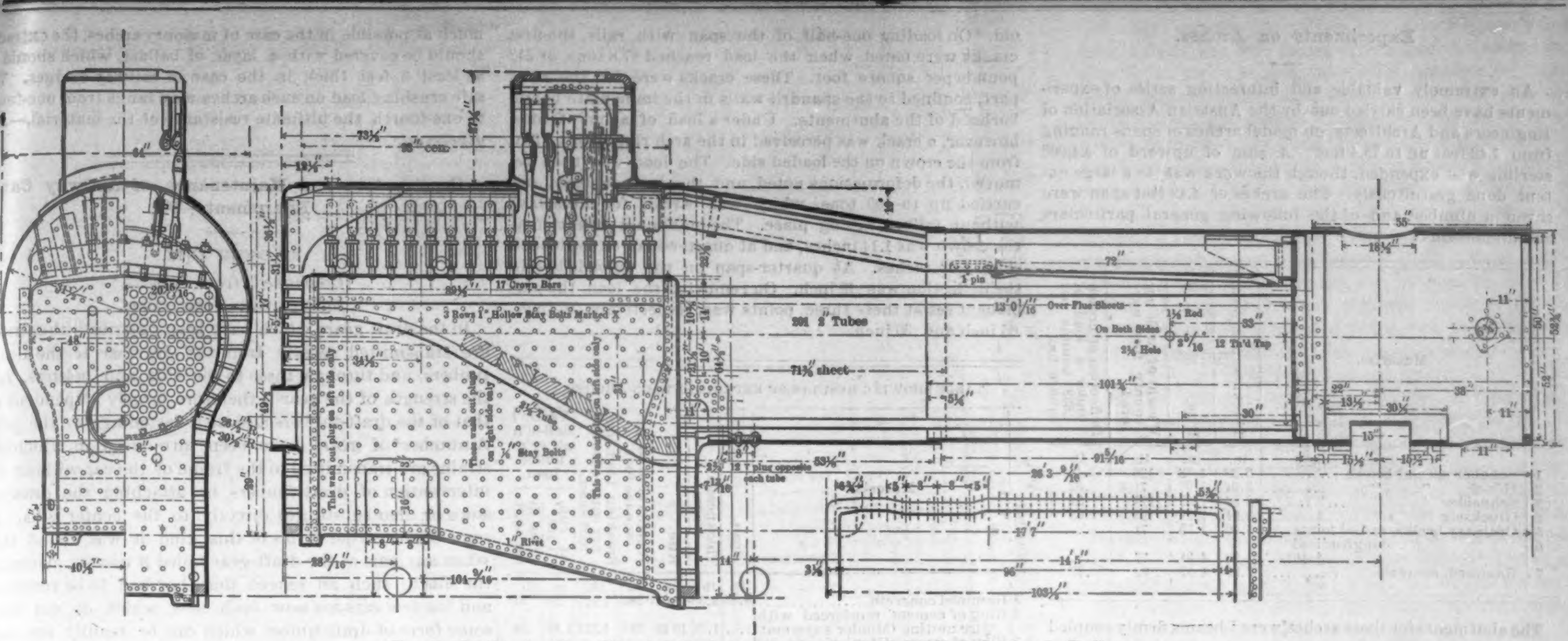


Fig. 2.—Boiler for Ten-Wheeled Freight Locomotive—N. Y. C. & St. Louis Railway.

are all formed in the solid metal, and therefore are not like an oil cup—liable to be lost. Over each of the eccentric rod pin holes, for instance, there is drilled transversely a hole 1½ inches in diameter and 2⅝ inches deep. It is then tapped with a ⅞-16 thread to the depth of ½ inch, and the hole closed by screwing a brass plug in flush. A ⅛-inch oil hole from the outside intersects this hole and passes on through the bushing that forms a bear ing for the pin. By filling the reservoir thus formed with waste, or a similar retaining material, a sufficient quantity of oil is provided for a long run. In the same way the link hanger pins are supplied with oil. The pin through the link block is lubricated from an open reservoir 1 inch by two inches by one and three-quarter inches in the top of the block. The whole arrangement it ingenious and should lead to a better lubrication with less waste of oil. It should also be noticed that the bushings in the link motion work are not of wrought iron, casehardened, but are of cast iron. Mr. McKenzie has used this material for several years with excellent results.

The eccentric straps on these engines have babbitt-filled grooves extending diagonally across the wearing surfaces. The eccentrics have a 4-inch face, giving ample wearing surface.

These engines have now been in service for some two months and have been a source of satisfaction to the management. Below we give a few of the principal dimensions:

Cylinders	18 inches by 24 inches
Steam ports	16 " 1⅝ "
Exhaust ports	16 " 3 "
Valve travel	5¾ "
Driving wheels	56 "
Driving wheel base	14 feet 0 "
Total wheel base of engine	23 " 10 "
Boiler style	Wagon top
Boiler, diameter of at first course	52 inches
Number of tubes	201
Size of tubes	2 inches O. D. by 13 feet
Firebox	34 inches by 95 inches
Grate area	22.4 square feet
Heating surface of tubes	1,360 " "
Heating surface of firebox	145 " "
Heating surface of arch tubes	10 " "
Heating surface, total	1,515 " "
Steam pressure	160 pounds
Weight on drivers in working order	87,000 "
Total weight of engine in working order	110,000 "

The driving wheels' centers are of cast steel, the axles and rods of hammered iron, and the crank pins of steel treated by the Coffin process. The driving boxes have facings of brass to wear against the driving wheel hubs. The shoes have bearing faces 6 inches wide for the driving boxes. The boiler material is carbon steel. A fire-brick arch is used and is supported on two water tubes. The driver brakes are of the equalized type, and the cylinder and fulcrum for the cylinder lever are attached to the same plate, making a neat arrangement.

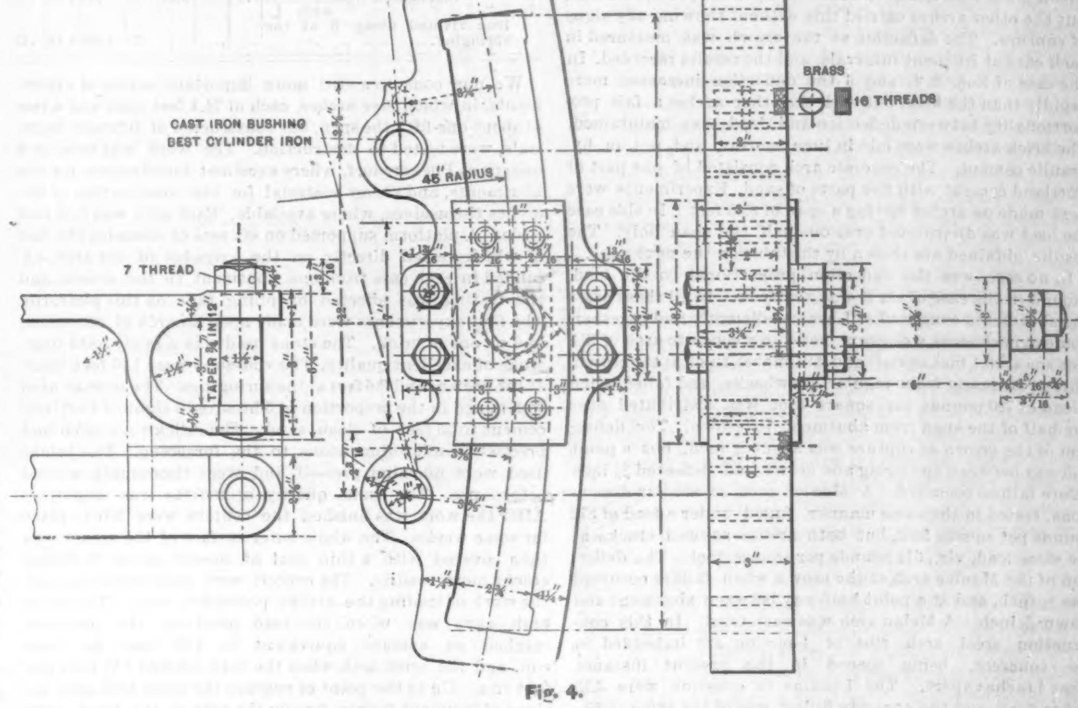


Fig. 4.

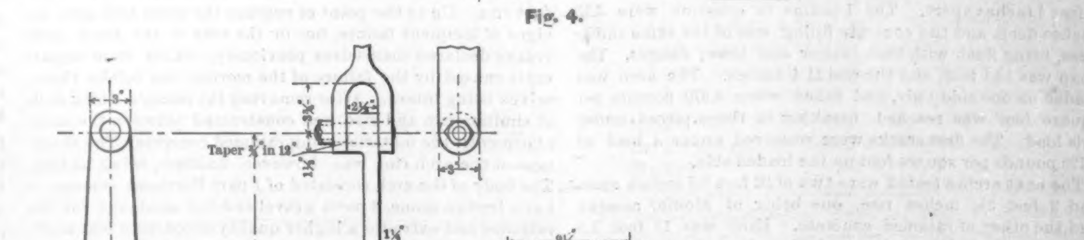


Fig. 5.—Link Motion for Ten-Wheeled Locomotive.

Inadequate Yard Facilities.

In a paper on "Transportation Facilities," recently presented by Mr. D. S. Sutherland, Superintendent of the Michigan Central Railroad, to the Central Association of Railroad Officers, the author pointed out that improvements in yard and terminal facilities had not kept pace with the increase of traffic. He said:

With very few exceptions, railroads are doing their switching the same as it was done when steam railroads first came into existence, and it costs these roads more to get a car through their yard than over any 100 miles of their line. In the first place, a train arriving pulls in and occupies a track in the distributing yard, and if several trains are in company a track is occupied by each, and no switching can be done until the whole fleet has arrived and is gotten out of the way, and the chances are that then this yard is blocked so as to render switching to any advantage almost impossible. A switch engine takes hold of the train and the first move is to pull the train back out of the yard, and for every cut that is made the whole or greater portion of the train must be handled, drawbars are pulled out or broken, and cars receive more damage than they will receive on a trip over the whole line.

Railroad companies realize that in order to meet competition, it is necessary to reduce grades, increase the capacity of engines and cars and in every way possible reduce the cost of transportation, but do not seem to realize that, in order to make this a success, it is necessary to equip their stations and terminals so as to meet the improvements in other quarters. If the capacity of freight engines is increased, it is just as necessary that the capacity of the yard be increased in proportion.

I know of no place where there is such a chance for reduction of cost in handling as at terminals. In order to accomplish this, yards need not necessarily cover any larger territory, but they can be so laid out that the switching can be done promptly and thoroughly, without loss of time and waste of power, and thereby a large reduction in cost and far better results arrived at. What is true of yards is also true of warehouses, meeting and passing tracks and all other transportation facilities.

Plans are being prepared for an addition of two stories to the office portion of the Grand Central Station, New York, and work on it will probably be begun in the spring. The additional office room is needed to bring all the clerical forces under one roof; they are now scattered in several buildings much to the inconvenience of everybody. The work will cost about $250,000.

Experiments on Arches.

An extremely valuable and interesting series of experiments have been carried out by the Austrian Association of Engineers and Architects, on model arches of spans ranging from 4.42 feet up to 75.4 feet. A sum of upward of £4,000 sterling was expended, though the work was to a large extent done gratuitously. The arches of 4.42 feet span were seven in number, and of the following general particulars and dimensions:

	Material.	Thickness at crown.	Rise.	Weight of arch per square foot covered.	Deflection of crown under a load of 1,638 pounds per square foot.
		in.	in.	lb.	in.
1	Schober special bricks	6.29	1.58	130	.46
2	Hönel " "	3.94	1.97	71.6	.62
3	Schneider " "	3.94	1.58	128	.94
4	Gluckselg " "	3.94	1.58	125	1.63
5	Ordinary bricks, radial joints	5.90	5.70	71	....
6	" " longitudinal joints	5.90	4.91	77	....
7	Rammed concrete	2.95	4.52	92	.77

The abutments for these arches were I-beams firmly coupled together by round tie-rods and channels. The arches were levelled up with earth packing, and loaded with pig iron distributed over the whole span. Failure in the case of Nos. 3 and 4 took place with a load of about 1,638 pounds per square foot, but the other arches carried this without showing any signs of rupture. The deflection at the crown was measured in each case at frequent intervals, and the results recorded. In the case of Nos. 3, 4, and 6 the deflection increased more rapidly than the load, but with the other arches a fair proportionality between deflection and load was maintained. The brick arches were laid in lime mortar, and not in hydraulic cement. The concrete arch consisted of one part of Portland cement with five parts of sand. Experiments were next made on arches having a span of 8.85 feet. In this case the load was distributed over one-half the span only. The results obtained are shown by the table on the next page.

In no case was the deflection proportional to the load, though in the case of six it was nearly so. In all these cases the abutments consisted of I-beams efficiently tied together. Some experiments were next made on a concrete arch of 13.3 feet span, 16.1 inches rise, and 3.94 inches thick at the crown. This arch sprang from regular skewbacks, and failed when a load of 790 pounds per square foot was distributed over one-half of the span from abutment to crown. The deflection of the crown at rupture was about ¼ inch, but a point midway between springing and crown had deflected ⅝ inch before failure occurred. A Monier arch of similar dimensions, tested in the same manner, failed under a load of 872 pounds per square foot, but both arches showed cracks at the same load, viz., 614 pounds per square foot. The deflection of the Monier arch at the crown when failure occurred was ¾ inch, and at a point half-way between abutment and crown $\frac{7}{16}$ inch. A Melan arch was next tried. In this construction steel arch ribs of I-section are imbedded in the concrete, being spaced in the present instance 3 feet 4 inches apart. The I-beams in question were 3.15 inches deep, and the concrete filling was of the same thickness, being flush with their upper and lower flanges. The span was 13.1 foot, and the rise 11.4 inches. The arch was loaded on one side only, and failed when 3,370 pounds per square foot was reached, breaking in three pieces under this load. The first cracks were observed under a load of 3,120 pounds per square foot on the loaded side.

The next arches tested were two of 32 feet 9.7 inches span and 3 feet 3⅝ inches rise, one being of Monier cement and the other of rammed concrete. Each was 13 feet 1.5 inches broad, and carried a single line of standard gage railway. The Monier cement arch was a reproduction of one constructed for actual use in 1889. It consisted of a ring of cement 5.9 inches thick at the crown, and 7.87 inches thick at the springings. The cement was, as usual on Monier's system, reinforced with wire netting. The dead load on the arch, including filling over haunches, ballast, and track, amounted to 307 pounds per square foot. As a preliminary, an engine and tender were run over the bridge and the deflections at the crown and at quarter-span noted. The locomotive had six wheels, the loads being distributed as follows: leading axle, 10.3 tons; driving axle, 13 tons; trailing axle, 13 tons. The tender had four wheels, the load on each axle being 9.1 tons. The maximum deflection noted was $\frac{1}{12}$ inch, of which one-half was permanent set. Still heavier locomotives were then run over the structure, the deformations being noted at 10 different points. No further deformation or permanent set was noted under these loads. Steps were then taken to test the arch to destruction, by piling rails over one-half the span. With 90 tons of rails thus distributed, a crack was observed in the neighborhood of the spridgings, extending through nearly one-third the total thickness of the arch. On increasing the load to 100 tons, further cracks were noted. This load was left on for 3½ hours, and the deflections recorded. The load was then totally removed, and the permanent set noted, which amounted to ⅝ inch at the crown. The load was then replaced and finally increased up to 180 tons of rails piled on the half span, when complete failure occurred. The vertical deflection at the crown, under a load of 80 tons, was .36 inches, and at the quarter-span .32 inch. At 90 tons the corresponding deflections were .44 inch and .42 inch, the first crack occurring at this load as already noted. At a load of 170 tons the deflection at the crown was 1.38 inches, and at the quarter-span 1.03 inches. The rammed concrete arch was of the same span, width, and rise; it was, however, 13.4 inches thick. It was built of concrete consisting of one part cement, two parts sand, and one part broken stone. The testing was commenced when the concrete was 224 days old. On loading one-half of the span with rails, the first cracks were noted when the load reached 47.8 tons, or 512 pounds per square foot. These cracks were, for the most part, confined to the spandril walls in the immediate neighborhood of the abutments. Under a load of about 90 tons, however, a crack was perceived in the arch ring about 2 feet from the crown on the loaded side. The load was then removed, the deformations noted, and the load replaced and carried up to 195 tons, which was carried for three days without failure taking place. The maximum deflection at the crown was 1.14 inches, and at quarter-span on the loaded side, 1.12 inches. At quarter-span on the unloaded side the deflection was .49 inch. On removing the load the permanent set at these three points was, respectively, .62 inch, .66 inch and .30 inch.

TABLE SHOWING RESULTS OF EXPERIMENTS ON ARCHES.

Number.	Material.	Span.	Thickness at crown.	Rise.	Weight of arch per square foot.	Breaking load, lbs. per square foot on half span.	Vertic'l deflec'n at cr'n under load. At rupture.	Vertic'l deflec'n at cr'n under load. Of 400 lb. per sq. ft.
		ft.	in.	in.	lb.	lb.	in.	in.
1	Rammed concrete	8.85	3.35	9.05	286	1,127	.94	.34
2	Ring of cement reinforced with wire netting (Monier's system)	....	1.05	10.23	230	1,217	1.01	.34
3	Ring of cement (Monier's system) levelled up over the haunches with concrete	...	2.17	10.23	506	1,320	1.22	.18
4	Arch of ordinary bricks	...	5.51	9.84	248	883	1.87	.77
5	" Honel bricks	....	3.94	5.31	166	491	1.53	1.45
6	" corrugated iron	....		9.84	14	973	1.06	.45
7	" " " with L-iron riveted along it at the springing	....	....	....	20	1,100	1.14	.47

We now come to a still more important series of experiments, in which five arches, each of 74.5 feet span and a rise of about one-fifth the span, but constructed of different materials, were tested to destruction. The work was done in a quarry at Puckersdorf, where excellent foundations for the abutments, and cheap material for the construction of the arches themselves, where available. Each arch was 6.65 feet wide. A platform supported on six sets of columns, the feet of which rested directly on the extrados of the arch, extended in each case from one abutment to the crown, and the testing was effected by piling rails on this platform. The first experiments were made upon an arch of cut stone, and on one of brick. The stone used was a fairly hard limestone of excellent quality. The voussoirs were 1.97 feet thick at the crown, and 3.6 feet at the springings. The mortar used was mixed in the proportion of 5 hundredweight of Portland cement to 35 feet of clean sand. The brickwork arch had precisely similar dimensions to the foregoing. The bricks used were machine pressed, and were thoroughly wetted before use. The same quality of mortar was employed. After the work was finished the centers were left in place for some weeks. The whole outer surface of the arches was then covered with a thin coat of cement, so as to detect cracks more readily. The centers were then removed, and the work of loading the arches proceeded with. The stone arch gave way when the load piled on the platform reached an amount equivalent to 1.99 tons per foot run, and the brick arch when the load reached 1.81 tons per foot run. Up to the point of rupture the stone arch gave no signs of incipient failure, but in the case of the brick arch cracks declared themselves previously, which were apparently caused by the failure of the mortar, the bricks themselves being intact. After removing the ruins, a third arch of similar span and rise was constructed between the same abutments, the material being rammed concrete. The thickness of the arch ring was, however, uniform, being 2.3 feet. The body of the arch consisted of 1 part Portland cement, 2 parts broken stone, 3 parts gravel and 3 of sand, but for the intrados and extrados a higher quality of concrete was used, that for the former consisting of one part Portland cement, ⅓ part broken stone, ⅓ part gravel, and 1 part sand, while the latter consisted of 1 part Portland cement, 1⅓ parts broken stone, 1⅓ parts gravel and 2 parts sand. The total quantity of concrete in the ring was about 50 cubic yards. Two months after completion the centers were removed, during which time the arch was protected from the sun and frequently watered. The testing commenced three weeks after the centers had been removed. Failure took place under a load equivalent to 2.24 tons per foot run on the loaded half of the arch. The next arch to be tested was constructed on the Monier system, the span and rise being as before, while the thickness of the ring was 1.97 feet at the springings and 1.15 feet at the crown. The concrete used consisted of 3 parts of river sand to 1 part of slow-setting Portland cement. The centers were removed at the end of two months, and arrangements made for testing. Failure took place under a load equivalent to 3.09 tons per foot run of the loaded half. Great difficulty was found in removing the ruins. The metal reinforcement was found intact, having bent, but not broken, at the points of failure.

The final experiments were made upon a steel arch of the same rise and span as the four preceding ones. This consisted of two steel ribs fixed at 5.9 feet centers and rigidly braced together. Each rib was of girder section 12.6 inches deep. The total weight of the steel work was 15.6 tons. On testing with a load of 82¾ tons distributed over half the arch, no serious deformation was observed. The load was then removed, and on the next day 158 tons of rails were piled up on the loaded side. The deflection was then considerable, but agreed well with the calculated result. This load was left in place throughout one night, after which rails were piled on the side not previously loaded till a total of 175 tons was reached. The deflection was still further increased, but not a single rivet yielded. The load was then removed, and the experiments terminated. From their experiments the committee concluded that in arches of large span the calculations may safely be based upon the theory of the elastic arch. With a view to distributing the load as much as possible in the case of masonry arches, the extrados should be covered with a layer of ballast, which should be at least 3 feet thick in the case of railway bridges. The safe crushing load on such arches may range from one-tenth to one-fourth the ultimate resistance of the material.—*Engineering.*

Construction and Maintenance of Railway Car Equipment.—V.

BY OSCAR ANTZ.

(*Continued from Page 53.*)

DRAFT GEAR—CONTINUED.

In the draft gears which have been described, the strains are transmitted mostly from the drawbar to the draft-timbers, and through these to the sills and bolsters, and the strength of the gear is therefore largely dependent on that of the draft-timbers and their fastenings to the sills. A number of gears have been introduced in which the strains are transmitted to the frame of the car without the intervention of draft-timbers, by attaching the drawbar stops or their substitutes directly to the center sills. In some of the earlier forms of this kind it was found that when any part of the draft-gear failed it usually damaged the sills to such an extent that they had to be renewed, and but few cars are now built new which do not have some form of draft-timber which can be readily renewed without disturbing the frame.

A draft-gear in which the strains are partly transmitted through the drawbar-stops directly to the frame of the car, while at the same time the larger part of the shocks is taken by the draft-timbers, is in extensive use, principally on the cars of a number of prominent roads in the Middle States, and it is shown in several forms in Figs. 24 to 29.

In this draft gear, as in the one described in the last article, thimbles are used as followers, having collars which bear along their circumference on the drawbar stops, the latter being mortised into the draft timbers at the sides and extended upward at the top and bearing on their ends against a solid filling block bolted securely to and between the center sills.

Figs. 24 and 25 show the original form of this gear, in which *N N* is a tail pin which passes through the cast-steel followers *L L* and the draft spring *P P*, and is secured by the key *U U* against the washer *Q Q*. The followers work in circular holes in the drawbar stops or cheek pieces *D D*, which are fastened each by two ⅞-inch bolts through the draft timbers and are mortised into these and the iron straps on the bottom. The upper parts of the cheek pieces are carried back at *E E* and bear against shoulders cut into a piece of timber. *G G*, which completely fills the space between the center sills for about 8 feet back of the end sill, and is securely fastened to the sills by five ¾-inch bolts. The upper lugs of the cheek pieces have slots in them to allow for inserting and removing the key through the tail pin, and the filling block is also cut out over the back cheek piece for the same purpose.

The draft timbers *A A* are of 4 by 8 inch oak, cut out ½ inch for the cheek pieces and drawbar spring and further cut out 1 inch deep for the projections on the sides of the cheek pieces. They are fastened to the center sills each by six ⅞-inch bolts *B B*, having their heads resting in cast iron sockets or box washers let into the floor. Cast iron key blocks *C C* and wrought iron tie straps *T T* are provided in the usual manner to further secure the draft timbers. Below the draft timbers are fastened by the bolts *B B*, the straps *F F*, made of ¾ by 3½ inch wrought iron about 3 feet long, with gibs at each end which are let into the timbers; the straps are also cut out 1 inch deep for the sides of the cheek pieces.

The wooden body-bolster and the arrangement of carry iron and other attachments on the endsill, which are shown on the drawing, are not an essential part of this particular draft gear, as any other kind of bolster and front attachments can be used. These are merely shown as being the usual form found on cars with this gear.

The disadvantages in the use of a tail pin or spindle in draft gears generally, have led to several modifications of the draft gear just described, whereby a pocket strap or an arrangement involving its principles is substituted for the pin.

Figs. 26, 27 and 28 show the simplest arrangement, the draft-timbers *A A*, and filling blocks *G G* being arranged substantially as described for the other form of gear, fastened together by bolts *B, B*, and key-blocks *C C*, the draft timbers having the straps *F F* on the bottom, and being tied together by tieplates *T T*. The cheek pieces *D D* are mortised into the draft timbers as before and are also extended upward and bear against shoulders on the filling blocks. These cheek pieces are provided just below the upper lug with a rectangular slot and are cut out at the bottom to allow the pocket strap *O O* to pass through. Between the back follower thimble *L* and the rear end of the strap a malleable casting *Q Q* is inserted, which is provided with a lug passing partly into the follower and with flanges which guide the strap, keeping it central. A piece of boiler tube, *U U*, is inserted in the followers and draft spring and serves to keep these in line. The pocket strap *O O* is of 1 by 4 inch wrought iron, is gibbed at its front end and is secured to the drawbar by means of two 1¼-inch bolts having double hexagonal nuts on their lower ends. The filling block and floor above these bolts are cut out, to allow for placing and removing them, and this hole is closed by

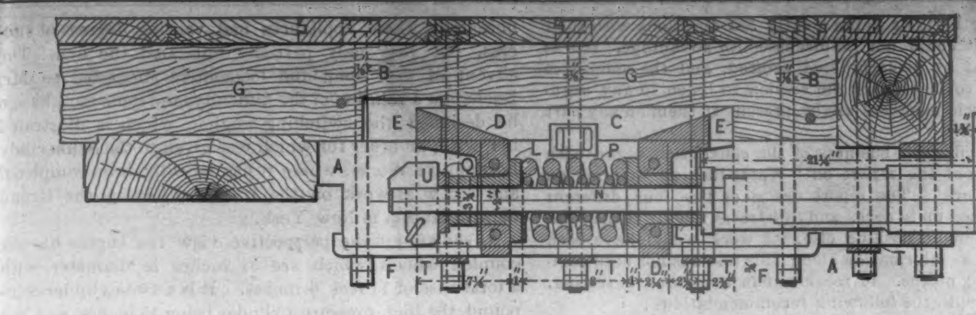


Fig. 24.

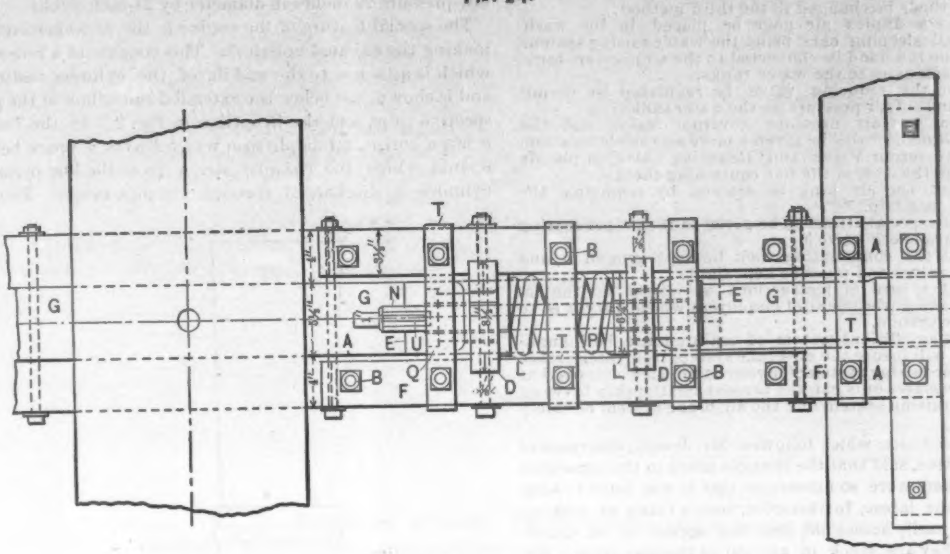


Fig. 25. Inverted Plan.

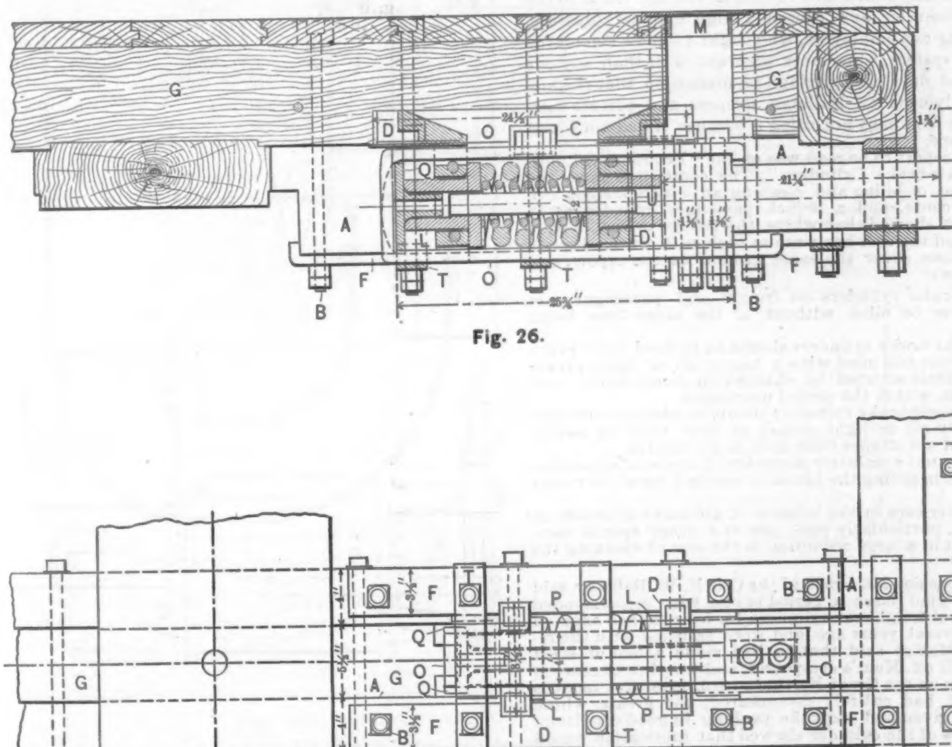


Fig. 26.

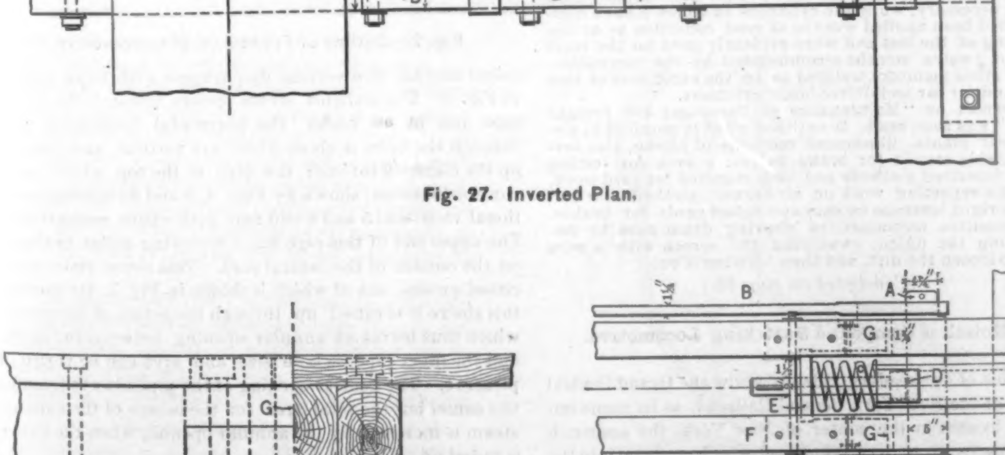


Fig. 27. Inverted Plan.

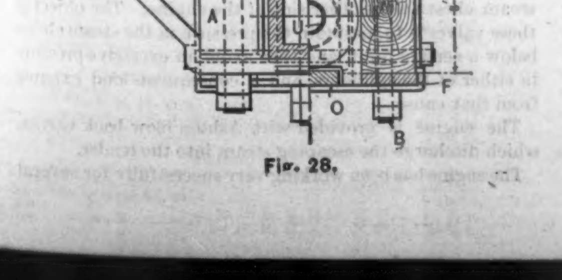
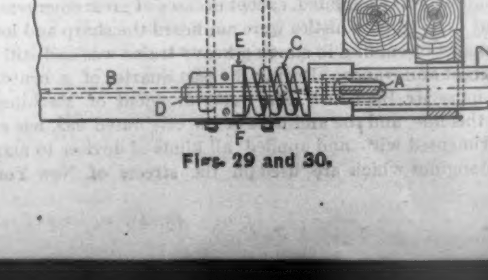


Fig. 28.



Figs. 29 and 30.

means of a casting, *M M*, let into and secured to the floor by screws.

Another variety of this draft gear, which is used to quite some extent, has two straps of ⅝ by 4-inch wrought iron, riveted on top and bottom of the drawbar by 1⅛-inch rivets, and extending back through the cheek pieces and fastened together behind the rear one by means of a 1¾-inch pin; this pin has a lug on one side of its top end, and the holes in the strap through which it passes are made of such shape that this lug will pass through in one position, but will rest on the top strap when given a quarter turn; the pin is locked in place by a key through its lower end, passing between lugs on a distance piece placed between the two straps, which also has a cylindrical lug on its front end which engages the back follower thimble; a piece of pipe or boiler tube is inserted in the two thimbles and the draft spring, and serves to hold these in place.

CONTINUOUS DRAFT GEARS.

In the different draft gears, as far as described, the strains are transmitted from the drawbar to the sills at each end of the car, and from one end to the other by the sills alone. There is a tendency in late years among car-builders to relieve the sills of some of the strains, both pulling and buffing; for the pulling strains this is done by bolting to each draft timber a 1-inch rod with a flat gibbed end, the rod passing back to and through the adjacent crosstie timber, and having a nut on its end resting on a large washer. The crosstie timbers are likewise connected by one or two rods passing between and through them, with nuts on the outside of each, making practically a continuous connection between the draft timbers at the two ends of the car. To take the buffing strains timbers are placed under the center sills, between the rear ends of the draft timbers and the adjacent crosstie timbers, and others between the two crossties, making practically a continuous timber from end to end. These subsills are bolted to the sills and are usually also keyed to them by cast-iron blocks. When wooden bolsters are used the draft timbers usually end at the bolster, and the subsills are fitted between the bolsters and crossties; with iron plate bolsters the draft timbers are sometimes carried back through them for a foot or two, being shouldered against the bolster. In either case, the short draft timbers can be removed if necessary without disturbing the subsills.

Instead of attaching the rods mentioned to the draft timbers, they are sometimes connected directly to the drawbars, forming the so-called continuous draft rigging. There are several kinds of this in use, the earliest introduced consisting of a long rod or spindle which passes through below the center sills and is connected to each drawbar by means of a key. The draft spring is placed directly against the end of the drawbar and at the other end bears against a wooden block fitted between the draft timbers, no follower-plates being used. When a pulling strain is applied to a car with this gear, the spring at the end opposite to the one at which it is applied is compressed; under a buffing strain, the spring at the end where it is applied, comes into action, so that there is always a thrust against one of the spring blocks. The slot in the drawbar or in the spindle must be made long enough to allow the spring to be compressed when subjected to buffing strains without moving a draft rod. This gear is not much used at present on cars of large capacity, although a modification of it was lately introduced in which the rod was made in two pieces, connected together at the center by means of a right and left turn-buckle, the connection to the drawbar being made by means of heads on the rods instead of the key.

These draft rods pass through the body bolster at the center, and therefore come in the way of the center pin which has to be cut off and is usually made with a head resting in a socket on the top side of the body center plate which must be removed to renew the pin. To overcome this objection the draft gear shown in Figs. 29 and 30 has been devised. The rear end of the drawbar is provided with a horizontal slot, through which a key *A A* of 1 by inch wrought iron passes; this key is long enough to also pass through the two draft-timbers and project about inches. Two draft rods *B B* are employed, which are made of 1¼ inch round iron and terminate on each end in a loop about 10 inches long, which is passed over the projecting ends of the draft key and secured in place by a cotter through the key on the outside of the loop. The crosstie timbers and wooden bolsters have to be cut out large enough to let the loop on end of draft rod pass through. The draft key is generally made ¼ inch narrower at the ends where the draft rods bear, so that they may be reversed to take up any lost motion which is liable to develop. The draft spring *C C* is secured to the drawbar by means of the tailpin *D D*, which passes through the stationary follower plate *E E*, which is mortised into the draft-timbers and is held in place by the follower plate supports *F F*. Bolts through the draft timbers, back of the follower plate, tie them together. The slots in the draft timbers through which the draft key passes are made about 1¼ inches longer than the width of the key to allow for the compression of the spring, and a piece of iron, *G*, bent in the shape of an angle, is fastened in this slot for the key to strike against. For heavy cars, two springs are sometimes used with this draft gear, each one bearing on a stationary follower plate and one tailpin passing through both springs.

(To be continued.)

Third Annual Convention of the Association of Railroad Air-Brake Men.

The third annual convention of the Association of Railroad Air-Brake Men met at the American House, Boston, Mass., at 9 a. m., April 14, President Hutchins in the chair. Prof. George F. Swain, of the Massachusetts Institute of Technology and member of the State Railroad Commission, made an excellent opening address, in which he gave some figures illustrating the comparative safety of railroad travel. Much of this safely be attributed to the efficiency of the air-brake, and increased speeds with safety as great as at present he held can only be obtained by greater intelligence in the use f the brake, better maintenance, and a more general equipment of cars with it. Hence the importance of the association's work. He also believed that it was actual economy for the railroads to spend money for freight brakes, because of the economies in train operation resulting therefrom, the safety and speed, and even the decreased headroom required for overhead bridges when men no longer have to walk on top of the cars of a train. In closing his remarks he welcomed the association to the city and expressed the hope that the convention would be a most profitable one.

President Hutchins replied for the association and then proceeded to read his address. He spoke of the rapid growth of the association to a membership of over 200 in three years, its good standing financially, the value of its work being recognized by the purchase of the reports of its proceedings to a phenominal extent, and to the general interest taken in its work. He touched on high speeds and the high-speed brake, slack adjusters and other improvements, but he emphasized the fact that the great work of the association was to suggest and carry out in practice betterments in the instruction of the men who handle the air-brakes and to attain a higher standard in the maintenance of the brakes. To do this they needed the support of superior officials, instruction cars and test yards. Air-brake cars should be ordered to the head of the train and used regularly. Occasionally we hear of a road ordering its men not to use the air on freight trains. Instead of being an exhibition of old fogyism it may be a punishment for rough handling of trains. In such cases the order might eventually do good as the men will use the brakes even if they have to steal their use and at such times they will learn to handle them with care to avoid detection. In closing, he complimented the association on the promptness with which it handled its business last year and hoped it would do as well in this convention.

The Secretary's and Treasurer's reports showed the membership to be 216, and the funds in the treasury, March 31, to be $922.35. Since that date $118 had been received, making over $1,000 in the treasury. Practically the entire edition of last year's proceedings, 2,000 copies, had been sold except the small number distributed to the members.

Several communications were then read; one from the New England Railroad Club, invited the members to attend its meeting held on the evening of the 14th; the New York, New Haven & Hartford Railroad invited the association to make an excursion over its line to Plymouth; the Fitchburg Railroad invited them to visit the interlocking plant at its Boston terminals, and Sherburne & Company invited them to visit its offices and see a sanding apparatus worked in conjunction with the air-brake. These invitations were accepted, and the various trips taken at hours that did not interfere with the sessions of the convention.

The first report of committees to be read was that on "Piston Travel." This report is a voluminous but an admirable one. It discusses the loss of air in brake applications when the piston travels are uniformly long, the evils of various lengths of travel in the same train resulting in slid wheels, etc.; lost travel or that part of the travel resulting from slack in truck bolsters, center plates, boxes, deflecting brakebeams, etc.; and records the results of tests made on the St. Paul & Duluth Railroad, with cylinders having indicators attached. Rules are suggested for air-brake tests of trains arriving at division terminals. The report closes with the following recommendations:

1st. That yard tests be made from a 90 pounds train pipe pressure and a full service application, and piston travel adjustments, based on this, be made 5½ inches for freight and 7 inches for passenger.

2d. That road tests be made from not less than 50 pounds pressure for freight and 60 pounds for passenger, and that adjustments be made to between 5 and 6 inches on freight and 6 and 7 inches on passenger where found less than 4½ inches on freight and 5½ inches on passenger, or where over inches on either.

3d. That brake cylinders of such size be employed as recommended in Westinghouse Air-Brake Company's circular of Dec. 1, 1895, that total leverage necessary to employ may not be excessive.

4th. That brake rigging (including beams) of sufficient strength be employed as will reduce deflection to a minimum.

5th. That lost travel due to truck construction and wear be as much reduced as possible.

The discussion was brief and was chiefly on the recommendation to use 90 pounds pressure for a yard test. Some claimed that it could not be obtaimed in many yards because of low steam pressure, and others doubted the wisdom of it, but the majority were in favor of it.

The next report to be considered was that on "Slack Adjusters." The value of a good slack adjuster was admitted but the committee had not found any device that could be pronounced perfect. It defined what an adjuster should do to fill the bill, the most desirable location for it, and the effect of the change in angularity of the brake levers as the slack is taken up. The committee conducted tests on this point to satisfy the doubting Thomas's and found the brake power was practically constant for large variations in the angularity of the levers.

The discussion brought out nothing new but served to emphasize the need of practical and successful devices of this kind.

The committee appointed to formulate a series of questions and answers on the air-brake next reported. Its report involved an immense amount of labor, but on account of its length—their being nearly 500 questions with their answers—it could not be discussed to advantage. It was disposed of by being ordered printed, and the committee requested to meet after the session to listen to any arguments which members might present to them on any part of the report.

The second day's business of the convention began with the reading of the report on "Water-Raising Systems on Sleeping Cars." The report describes the four different methods used up to date, and illustrates them. If the committee had done nothing else, its work would have been important, as information along this line has not been complete by any means. It recommends a method of testing, and closes with the following recommendations:

1st. That all water-raising systems using the first and second methods be changed to the third method.

2d. That a duplex air gage be placed in the wash-room of all sleeping cars using the water-raising system, and that the red hand be connected to the air pressure tank, and the black hand to the water tanks.

3d. That the reducing valve be regulated to permit but 20 pounds of air pressure on the water tanks.

4th. That the air pressure governor valve and the pressure reducing valve be given a more accessible location, and that "Governor Valve" and "Reducing Valve" be plainly stencilled on the door of the box containing them.

5th. That the air tank be drained by removing the drain plug each trip.

6th. That especial attention be given to the proper seating of non-return check valve 5.

7th. That the combination cock be kept ground in, and the water valves and pipes be kept tight.

8th. That a card of instructions be issued for the information and government of employees whose duty it is to care for the system.

9th. That an efficient system of maintenance be inaugurated that will insure the air-brake system from interference of the water-raising system; for your committee believes that by such measures only can the present relationship between the water-raising system and the air-brake system be safely continued.

In the discussion which followed Mr. Jesson, chairman of the committee, said that the changes made in the apparatus by the makers were so numerous that it was hard to keep posted on the latest; furthermore, such a thing as making the valves easily accessible, does not appear to be considered, and they are stuck in any out-of-the-way place. Mr. Nellis said that he had found several slid wheels caused by the device, and in each case they were due to leakage in the non-return check, valve 5, which in the operation of the brake practically added the volume of the air tanks to the auxiliary reservoir, and caused a high cylinder pressure. The sleeping-car employees, who ought to know something about the system, were more ignorant of it than any one else. It also developed during the discussion that the system was only used on Pullman sleepers and private cars, the Wagner company not using it because it had not found it satisfactory.

The next report to be read was on the "Economical Lubrication of Air-brake Cylinders." The committee gave the average cost of oiling and cleaning an 8-inch freight cylinder as 9 cents, and a 10-inch passenger cylinder as 12 cents, but it showed that where the freight cylinders were badly located the cost has risen as high as 60 cents. Its recommendations cover the same ground as the report, and are as follows:

1st. Air-brake cylinders on freight and passenger cars should never be oiled without at the same time being cleaned.

2d. Freight-brake cylinders should be cleaned once every twelve months and oiled with a heavy oil or light grease that is but little affected by changes in temperature, and will not gum within the period mentioned.

3d. Passenger-brake cylinders should be cleaned and oiled with a heavy oil or light grease at least once in twelve months, and not oftener than once in six months.

4th. While not absolutely necessary, there is an advantage to be gained in giving the piston a one-half turn every six months.

5th. Greater care in the location of air-brake cylinders on freight cars, particularly coal, ore and other special cars, would result in a large reduction in the cost of cleaning the same.

In the discussion Mr. Pratt, of the C. & N. W. Railway, said that he was glad to see a period of one year recommended for cleaning of freight car cylinders, for his road had adopted that rule several years ago and were satisfied with the results. Mr. McKee said that he had made a test of West Virginia well oil, Kent's compound, and another grease, in car cylinders on the Great Northern road; after five months the well oil had entirely disappeared, the grease whose name is not given had kept the packing in good condition, but the walls of the cylinder showed that lubrication would soon be necessary, while the cylinders to which Kent's compound had been applied were in as good condition as at the beginning of the test and were evidently good for the total period of twelve months recommended by the committee. Several other members testified as to the excellence of this compound for car and driver brake cylinders.

The report on "Maintenance of Passenger and Freight Brakes" was then read. It outlined what is required in air-brake test plants, illustrated methods of piping, also several portable stands for brake valves, a rack for testing triples, described methods and tools required for yard work, a form for reporting work on air-brakes, methods for getting the right leverage on cars and defect cards for brakes. The committee recommended clearing drain cups by disconnecting the union, swabbling the screen with a wire brush to loosen the dirt, and then blowing it out.

(*Concluded on page 83.*)

A Noiseless Compound Switching Locomotive.

As most of our readers probably know the Grand Central Station of the New York Central Railroad, as its name implies, is located in the center of New York, the approach to it being by an underground road which emerges into the open a short distance north of the station. The switching of the passenger trains required by its immense traffic must therefore be done in close proximity to resident streets on each side of it. Long ago the use of steam whistles, by switching engines, was prohibited, except in cases of great emergency. But even when whistles were not heard the sharp and loud exhaust of engines in starting heavy trains was and still is a great annoyance. During the past quarter of a century or more Mr. Buchanan, the Superintendent of Machinery of this line, and the architect of the celebrated 999, has experimented with and applied all kinds of devices to make the engines which are used in the streets of New York noiseless. These appliances had varying degrees of success, but they only partially mitigated the evil. The advent of the compound locomotive suggested to Mr. Buchanan a solution of the difficulty, and some months ago he designed the switching engine, which is illustrated herewith, an order for which was given to the Schnectady Locomotive Works, where it has recently been completed and is now at work on the tracks adjoining the Grand Central Station in New York.

As shown by the perspective view the engine has six coupled wheels, which are 51 inches in diameter, with a total base of 11 feet 6 inches. It is a two-cylinder compound, the high-pressure cylinder being 19 inches, and the low-pressure 29 inches in diameter by 24-inch stroke.

The special feature of the engine is the arrangement for making the exhaust noiseless. This consists of a receiver, which is attached to the middle of the cylinder castings, and is shown just below the extended smokebox in the perspective view, and also in outline in Fig. 2. In the inside it has a horizontal diaphragm which leaves a space below it, into which the exhaust steam from the low-pressure cylinder is discharged through the pipe below. The receiver also has two vertical diaphragms with holes shown in Fig. 3. The exhaust steam enters through the lower pipe, and passes under the horizontal diaphragm and through the holes in those which are vertical, and escapes up the chimney through the pipe at the top, which has a variable exhaust, shown by Figs. 4, 5 and 6—4 being a sectional view, and 5 and 6 end and plan views respectively. The upper end of this pipe has a revolving collar or sleeve on the outside of the central part. This sleeve rests on inclined guides, one of which is shown in Fig. 5. By turning this sleeve it is raised up through the action of the guides which thus leaves an annular opening between the sleeve and the inner pipe, whose size and area can be varied at pleasure. The central opening of the pipe always remains the same, but the total area for the escape of the exhaust steam is increased by the annular opening when the sleeve is raised up.

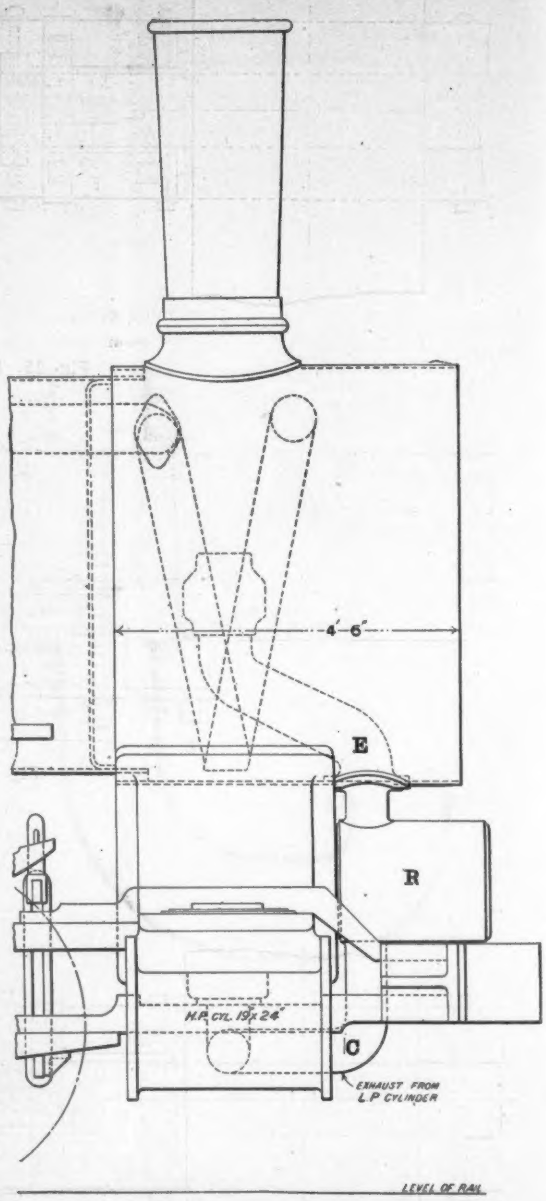


Fig. 2.—Outline of Front End of Locomotive.

In the perspective view a relief valve is shown attached to the front end of the steam chest. This valve is connected to the receivers by a pipe, which is also shown in the view. A similar valve is attached to the high-pressure steam chest on the other side of the engine. The object of these valves is to maintain the pressure in the steam chests below a certain limit, and thus avoid an excessive pressure in either of the cylinders, and a consequent loud exhaust from that cause.

The engine is provided with Ashton blow back valves, which discharge the escaping steam into the tender.

The engine has been working very successfully for several

Fig. 1.

Compound Noiseless Switching Locomotive, for the New York Central & Hudson River Railroad.

Designed by Mr. Wm. Buchanan, Superintendent of Motive Power. Built by the Schenectady Locomotive Works, Schenectady, N. Y.

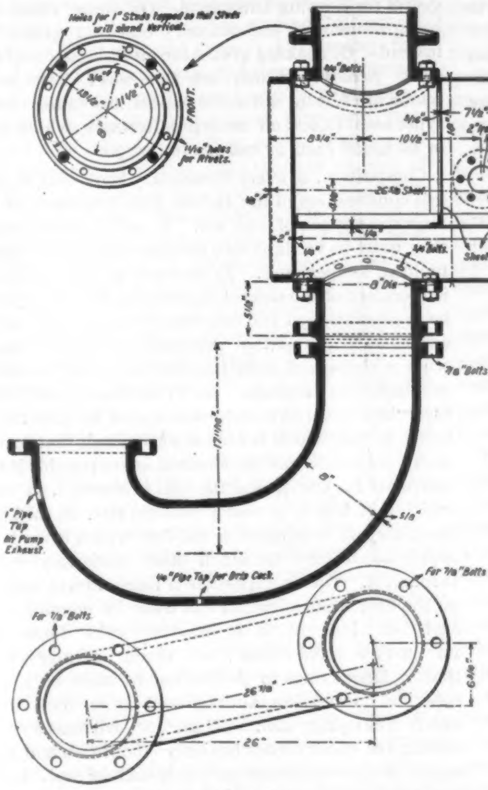


Fig. 3.

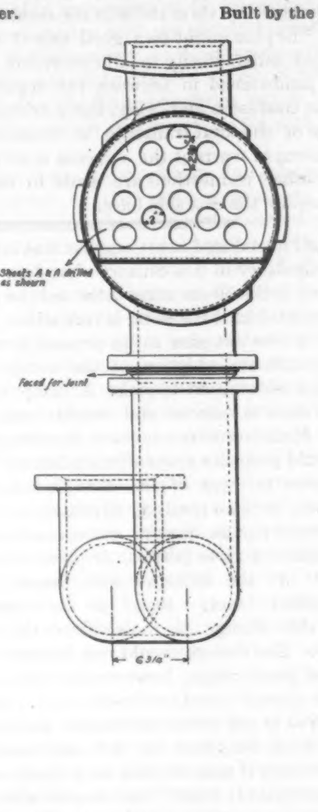


Fig. 4.

Exhaust Box.—Compound Switching Locomotive.

weeks, and while it cannot be said that it is at all times absolutely noiseless, it is true that the only time when any noise is heard is during the first two or three revolutions after starting when a very soft discharge is perceptible. After that a person a few yards away could not tell from the sound of the exhaust, that a locomotive was at work near them. This plan seems to afford the means of making the exhaust of locomotives so nearly perfectly noiseless that it will not be a cause of disturbance or annoyance to those who live, work or sleep in the closest proximity to them.

The engine steams very freely notwithstanding the fact that the exhaust is noiseless, but which seems to have sufficient effort upon the fire to maintain steam at the required pressure, which is 190 pounds.

The following are the principal dimensions of this engine:

General Dimensions.

Gage....4 ft. 8½ in.
Fuel....Anthracite coal
Weight in working order....125,000 lbs.
" on drivers....125,000 lbs.
Wheel base, driving....11 ft. 6 in.
" " rigid....11 ft. 6 in.

Cylinders.

Diameter of cylinders....20 R. H. 19 in. L. H.
Stroke of piston....24 in.
Horizontal thickness of piston....5¾ in. at hub, 4¾ in. at rim.
Diameter of piston rod....3½ in.
Kind " " Packing....Plain rings of cast iron.
" " " rod packing....United States metallic.
Size of steam ports,
L. P. R. H. 20 in. × 1½ in. H. P. L. H. 18 in. × 1½ in.
Size of exhaust ports. L. P. R. H. 20 in. × 3 in. H.P.L.H. 18 in. × 3 in.
" " bridges "....1⅛ in.

Valves.

Kind of slide valves....Richardson balanced.
Greatest travel of slide valves....5½ in.
Outside lap " " "....L. P. R. H. ⅞ in. H. P. L. H. 11/16 in.
Inside lap " " "....L. P. R. H. 1/16 in. H. P. L. H ⅛ in.

Lead of valves in full gear....1/16 in.
Kind of valve stem packing....United States metallic.

Wheels, etc.

Diameter of driving wheels outside of tire....51 in.
Material " " " centers....Steeled cast iron.
Tire held by....Shrinkage.
Driving box material....Steel cast iron.
Diameter and length of driving journals....8 in. dia. × 9 in.
" " " " main crank pin journals. 5½ in. dia. × 5 in.
" " " " side rod " " "....Main 5¾ in.
dia. × 5 in. F. & B. 4½ in. dia. × 3½ in.

Boilers.

Style....Wagon top.
Outside diameter of first ring....60 in.
Working pressure....180 lbs.
Material of barrel and outside of firebox....Carbon steel.
Thickness of plates in barrel and outside of fire box,
Throat ⅝ in., balance 9/16 in.
Firebox, length....107½ in.
" width....42 in.
" material....Carbon steel.
" crown staying....5 in. × ¾ in. crown bars welded at ends.
" stay bolts....1 in. dia.
Tubes, material....Mild steel No. 11 W. G.
" number of....271
" diameter....2 in.
" length over tube sheets....11 ft. 0 in.
Heating surface, tubes....1547.5 sq. ft.
" " firebox....162 sq. ft.
" " total....1709.5 sq. ft.
Grate "....31.24 sq. ft.
Exhaust pipes....Single, muffled through exhaust box.
" nozzles....Variable 5 in. and 8 in. dia.

Tender.

Weight, empty....28,500 lbs.
Wheels, number of....8
" diameter....30 in.
Journals, " and length....3¾ in. dia. × 7 in.
Wheel base....14 ft. 4½ in.
Tender frame..S. L. W. Standard. 6½ in × 4 in. × ¾ in. angle iron
" trucks.. " " channel iron center bearing
Water capacity....3,000 U. S. gallons
Coal "....3½ tons
Total wheel base of engine and tender....39 ft. 5½ in.
" length, " " " "....52 ft. 4⅜ in.

The engine house is fitted with Westinghouse-American combined brakes on all drivers, tender and for train, magnesia sectional boiler covering, one 3-inch Consolidated muffled and one 3-inch Ashton blow back sofety valve and central steel brakebeams.

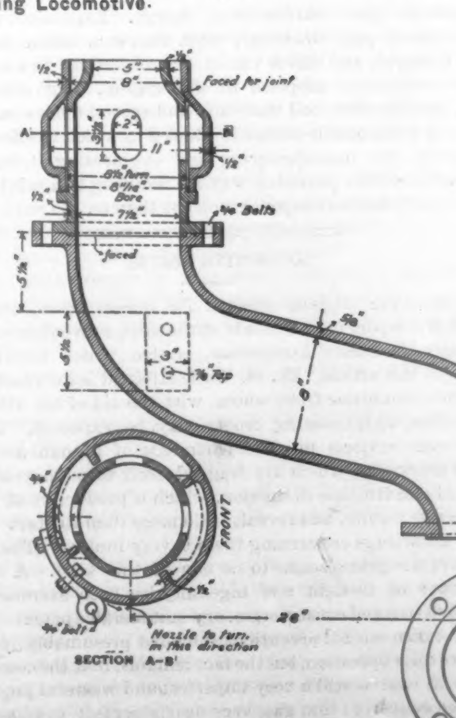


Fig. 5.

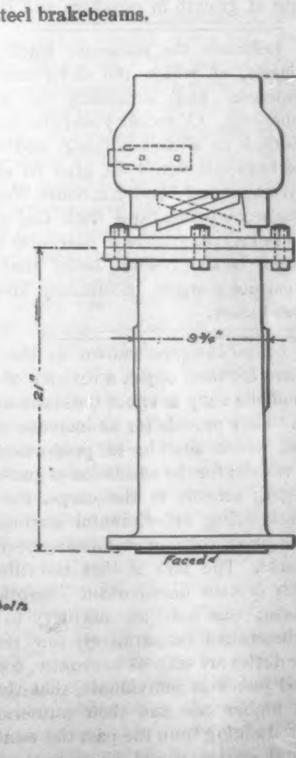


Fig. 6.

Variable Exhaust.—Compound Switching Locomotive.

(Established 1832.)

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The third annual convention of the Air-Brake Men's Association was held in Boston last month, and we would direct the attention of our readers to the proceedings as summarized elsewhere in this issue. While our account is necessarily brief, the proceedings of the convention were of a high order, and the business was handled in a prompt and thorough manner. The reports presented exhibit the results of thorough and painstaking work, and are a credit to the association. They compare favorably with the reports to the other and older associations, and in view of the importance of the subjects with which the association has to do, and the excellence of the work it has thus far accomplished, it certainly merits a continuation of its rapid rate of growth in numbers and influence.

On English railroads the passenger traffic is divided into several classes, of which the third class is by far the most numerous and, according to all reports, the only profitable one. Of recent years the second class traffic has dwindled to almost nothing, and one would think the railroad officials would be glad to abandon it. But the Great Western and London & South Western roads have reduced the second-class fares with the expectation of inducing third-class passengers to patronize the second class. It appears to be the general belief that this step may delay, but cannot postpone indefinitely, the abandonment of the second class.

The bills now before Congress known as the "Wilson-Squire" bills, have for their object a revision of such rules and regulations of the navy as effect the status and authority of engineers. They provide for an increase in the number of the corps, which shall be in proportion to the increase of naval vessels; for the admission of graduates from civilian engineering schools to the corps, the establishment of an engineering experimental station, and the transfer to the engineer corps of certain engineering duties now in other hands. The fact is that the rules as they now stand, with certain unimportant exceptions, were framed when steam was only an auxiliary to sails, and when naval engineers had comparatively few responsibilities. Now their duties are such as to require, for the good of the service and justice to individuals, that their standing should be a higher one and their authority greater than at present. Judging from the past the establishment of an experimental station would be productive of much good, for it has been notably true of all experimental work undertaken by engineers in the employ of the government, that the time and money have been wisely expended. It appears that nearly every nation is or has been tardy in according to its naval engineers the status they deserve, but the agitation for justice to these officials has been strong and persistant. We trust that in the case of our own country it will result in much needed reforms.

The scheme of carrying the cars of the elevated roads of New York and Brooklyn over the bridge between the two cities so that passengers can make a continuous trip from any part of one city to any part of the other reached by the roads, is one that might meet with the approval of the traveling public if the details of the plan were more favorable to the two city governments. It is proposed that the roads shall pay a rental equal to the present earning power of the bridge railroad, the cities to pay for the changes at the terminals necessary for the through traffic, and the roads to charge only five cents for a ride from any station in one city to the further bridge terminal. The objection is urged that while this would eliminate the present bridge fare of three cents for such passengers as use both the elevated and the bridge, it would increase the fare from three to five cents to those who at present use the bridge only. The rental proposed is also held to be inadequate, especially on a lease for as long a period as 50 years, and it is pointed out that the cost of rearranging terminals and the payment of damages incidental thereto, all falls upon the cities, so that the railroads obtain the use of the bridge without any or but little initial outlay. The cry is also raised that the elevated roads will not operate the bridge road with the same regard to the safety of the public as has been exercised in the past, but that charge may surely be dropped in view of the record for safety already made by these roads in the conduct of their business. The plan might be a good one if the details can be arranged satisfactorily to all concerned, and the elevated trains sandwiched in between the regular bridge trains without confusion and delay, but it is doubtful if the percentage of the total traffic to be benefited by the change is sufficient to warrant the expense involved in the plan, unless other connections are made to the bridge in New York besides the east side lines.

The bill introduced into Congress making the metric system compulsory in this country after Jan. 1, 1901, has been sent back to the House committee and the probability of its being adopted in this session is very slim. It will be a good thing if it does not pass in its present form. We believe that the ultimate adoption of the metric system in this country is certain, but to make it compulsory and at such an early date is unwise and would work a hardship to many. Manufacturers who have considerable foreign business would probably reap sufficient benefit from it to offset the expense to them of the change, but there are many others who have no resulting advantages to look forward to, and these parties deserve more consideration than the bill mentioned gives them. If it is conceded that the adoption of the system will some time be an accomplished fact, then it is clear that the earlier the change is undertaken the less expensive it will be. The change should not be attempted without plenty of preparation, however, as without it the cost would be excessive and needlessly great. Such legislation as is desired in aid of this movement should be framed on more practical lines than the bill mentioned. The large manufacturers, if assured that only reasonable legislation was contemplated, would doubtless be able to suggest the lines on which a satisfactory law could be framed. They have a right to be heard in this matter, for upon them will come the great burden of a change. Expensive scales, templates, jigs, drawings, taps, dies, etc., would have to be changed, and this is one of the objections to a sudden and compulsory adoption of the system. But drawings become obsolete, and templates and special tools wear out, and if a reasonable period is allowed in which to effect the change, the manufacturing and engineering industries could doubtless provide a way for reducing to a minimum the confusion and expense incident thereto.

LOCOMOTIVE GRATES.

One of the subjects selected for investigation, and on which a report is to be made at the next convention of the Master Mechanics' Association, is that which forms the title of this article. Mr. H. Wade Hibbard is the chairman of this committee from whom, with the aid of his able coadjutors, an interesting report may be expected. There are some subjects in all departments of human activity and knowledge which are dragged along through years of vapid and fruitless discussion, which is productive of only negative results, and reveals little more than the fact that our knowledge concerning them is very limited. The subject of fire grates seems to be one of this kind. A vast amount of thought and ingenuity has been exercised in their design and construction, and innumerable patents have been taken out for inventions intended presumably to improve their operation, but the fact remains, that the combustion of coal is still a very imperfect and wasteful process. When converted into gas, very nearly perfect combustion of coal may be obtained, but when it is burned in its solid form a large percentage of its calorific value is wasted. Now this is due very largely, it is believed, to what may be called the "environment" of the fire, and it seems probable that very considerable economy would be possible if what may be called the contiguities of combustion were investigated and adapted to produce the result aimed at. Thus we are not aware that any exhaustive experiments have ever been made to show what is the most advantageous width of grate bars and openings between them for burning different kinds of coal. Obviously if the bars are too thick when fine coal is burned there will be an imperfect dissemination of air through the fuel, and if the openings are too wide much of the coal will fall through and therefore will not be burned. If on the other hand the bars are too thin and the spaces too narrow the bars may melt out and the spaces be clogged by ashes or cinders or both. It is thought that the student will look in vain through engineering literature for satisfactory information with reference to the best width of bars and openings for burning given qualities or grades of coal. An investigation to show what forms and proportions of grates are best adapted to burn different qualities of fuel, under different conditions, would involve much labor and expense and it could hardly be expected that a committee constituted like the one referred to could give the time nor has it the money for such research, but a distinct advance would be made if they should merely formulate our ignorance of the subject.

It might very properly be asked of the Committee what are the best proportion of grates for burning, say, buckwheat, stove, or run of mine anthracite coal, or the different grades of bituminous, such as Cumberland, Pennsylvania, and the Western coals, which clinker very badly. If in response to such enquiries the Committee would say that they don't know and cannot find out that anyone else does, it would be a gain.

Then there is the disputed question of the value of water grates for burning anthracite. On some roads these are being abandoned, and ordinary cast-iron grates are used instead. Of shaking grates for bituminous coal there is a great variety. Which are the best? The preferences which are felt by different master mechanics for certain types seem to rest on mere predilections, which have little or no sound facts or reasons to rest on.

Combustion, as every elementary book tells us, is a chemical combination of the carbon and hydrogen of the coal with the oxygen of the air. To effect this combination they must be brought into contact and there must be an igniting temperature. To produce perfect combustion it is therefore of the utmost importance that the grate should be so proportioned and constructed as to admit air to the coal so as to completely permeate the whole mass, and, what is perhaps of equal importance, is that the coal should be adapted to the grate. Every fireman knows that if the fuel which is thrown on the fire varies in size from large lumps to that which is almost pulverized, that not nearly such good results can be obtained as are possible if the large lumps are broken up and the coal is assorted, so that that which is burned is of nearly uniform size. In the latter case the grate can be adapted to the fuel which is used, and the supply of air may be much more uniformly distributed through it. This is impossible if large lumps are thrown on the fire, because the air can come in contact with the fuel so long as it is in the solid form only at its surface, and this is much greater in small than in large lumps in proportion to their bulk. Thus a spherical lump containing one cubic inch has very nearly five square inches of surface, whereas a lump containing ten cubic inches has only about two and a quarter square inches of surface per cubic inch of coal. It is therefore very much easier to bring the air into contact with the fuel when it is broken up into small pieces than it is if the fire is fed with large lumps. But if it is very fine it will pack closely, and then unless the grate has many small openings it is difficult to supply enough air to the whole mass.

To maintain good combustion it is essential, too, that the temperature of the fire should be kept above the point of ignition. If the temperature is reduced in any part of the fire below the point at which the gases will burn combustion is checked. Now, perhaps, few persons realize how much the temperature of a fire is reduced when fresh coal is thrown on it. It is not merely that the fuel must be heated from the external temperature to that of the fire, but as soon as the coal is heated it is converted into gas, and in that process a very large amount of heat is absorbed or becomes latent. Rankin called it the heat of gasification, which is very expressive. This phenomena is exemplified if we heat water in the atmosphere to a temperature of 212 degrees. To do this each pound of water will absorb 212 heat units, supposing its temperature was at zero in the beginning. If we continue to add heat the whole pound will be converted into steam, whose temperature will not at any time exceed 212 degrees. But to vaporize it besides the 212 units to heat the water it will require 966 additional units to convert the water into a gas.

This is the heat of gassification which is absorbed or becomes latent when the water is changed from a liquid to a gaseous form. A similar phenomena occurs when fresh coal is thrown on the fire and is converted into gas, the effect of which is to absorb heat from the fire. If the amount so fed to the grate is excessive the temperature about the fresh fuel may be re-

duced below the igniting point and combustion is thus partially or wholly arrested. The fuel and the grate should therefore bear such a relation to each other that the former may be distributed over the latter and so that air may be admitted through the whole mass of the fuel. One of the problems presented to the committee then, is to formulate such proportions for grates, as will most effectually accomplish this result, with different kinds of coal.

But there are other questions relating to what has been called the environment of the fire which ought to be considered. In Kent's excellent Mechanical Engineers' Pocket Book, he quotes Rankin, who says, "if disengaged carbon is maintained at the temperature of ignition, and supplied with oxygen sufficient for its combustion, it burns while floating in the inflammable gas, and forms red, yellow or white flame. The flame itself is apt to be chilled by radiation, as into the heating surface of a steam boiler, so that the combustion is not completed, and part of the gas and smoke pass off unburned." The temperature of water in a boiler with a steam pressure of 150 pounds per square inch is only 366 degrees whilst the temperature of gaseous flame is about 4,000 degrees it will therefore be seen as observed by Frederick Siemans "what a quenching effect the metal of the boiler, which is of course at the temperature of the water, has upon the flames." He also called attention to the fact that "when flame is brought into contact with any solid body, it is more or less quenched, according to the substance, size and temperature of the body. Take any ordinary illuminating gas flame, such, for instance, as a batswing, and place a glass rod or tube into the middle of it, the flame will immediately burn dull, and a large quantity of lamp-black will be deposited on the piece of glass. This action is most marked when the rod is cold, but takes place, though in a less degree, at any temperature, for the reason that the material to be heated is necessarily always at a lower temperature than the flame, also owing to the disturbance in the combustion caused by contact of the solid substance with the flame." Continuing, this distinguished authority announces this important principle in relation to combustion—"experiments I have made," he says, "establish the following most important fact, namely, that a good flame, or in other words, *perfect combustion can only take place in an open space or in one of sufficiently large size to allow the gases to burn out of contact with solid material.*" This principle, it is believed, is of very great importance in the combustion of coal especially in locomotives, many of which necessarily have a limited amount of space in their fireboxes. If these are too narrow, the flame must come in contact with the sides, and if they are shallow with the crown-sheet. Every fireman has observed how prone the fire in a locomotive firebox is to become dead along the sides and the front and back ends of the firebox.

The fire here is in contact with the cold surfaces, and the flame comes in contact with solid material. It would seem to be wise, then, to widen the fireboxes of locomotives, whenever this is possible, and give them ample depth. This, however, can only be done in new designs, and should undoubtedly be aimed at in all cases. But can nothing be done in the existing forms and proportions of fireboxes? The deadening effect referred to is due to the contact of the fuel and the fire with the sides of the firebox. This can be avoided by constructing the grates with dead plates or firebrick all around them and between the open part and the firebox plates. If these are inclined somewhat steeply they will keep the fuel away from the cold plates, or if made flat they will speedily be covered with ashes or cinders which will have the same effect. Combustion in a very shallow firebox would undoubtedly be improved by lowering the grate below the sides of the firebox when this is possible. The principle to which it is intended to direct the attention of the committee is that enunciated by Mr. Siemans, and the object to be aimed at is to construct grates so as "to allow the gases to burn out of contact with solid material," as far as that is possible.

Another matter is also worthy of their attention—that is, the rate of combustion on grates. It does not seem to be at all certain that the principle which has been hastily assumed that the slower the combustion the greater is the economy. There probably is some rate for locomotives which is more economical than any which is slower or faster, and it may be that this rate has some relations to the speed and the loads hauled. Be this as it may it seems very probable that a grate which is sufficiently large to be economical when the maximum demands are to be made on it, would be too large for economy when the engine is not consuming so much steam. This suggests a grate of variable size, which perhaps is worthy of consideration by the committee.

There has lately been some discussion with reference to the slope of grates in marine boilers and it has been advocated that instead of sloping downward from the furnace doors they should incline the reverse way. In locomotives sloping grates have always been made lower at the front end than behind. Is it quite certain that this is the best form of construction? In some kinds of engines this is essential in order to get the rear axle under the firebox, but in some other types it would be a distinct advantage to have it higher in front.

A collateral subject relating to grates is that of furnace doors. There can be no doubt of the fact that having the furnace door open so large a portion of the time when a boiler is worked the hardest has a very deleterious effect upon the fire. Probably most engineers would agree that the steaming capacity of a locomotive boiler would be greatly diminished if the door was kept open all the time. There is every reason for believing that the deleterious effect of having the door open is in proportion to the time it is open. In ordinary hand firing probably the door is open one third of the time, the effect of which is just one-third as bad as though it was open all the time. Is not some form of automatic opening door possible or some way of feeding coal to the fire without opening communication wide for the admission of cold air?

The Committee has an opportunity of making an interesting and valuable report.

TIMBER.

AN INVESTIGATION OF ITS CHARACTERISTICS AND PROPERTIES.

Probably comparatively few of the practical railroad men of the country are aware of the extent of the work which has been undertaken by the Forestry Division of the United States Department of Agriculture, under the charge of the able chief of that division, Mr. B. E. Fernow. The results of this work have been given to the public in a series of bulletins, whose value has probably been appreciated by only a few of those who would be most benefited by the wealth of information which these bulletins contain. The conception of this work dates back about ten years, when Mr. Fernow was first appointed to the office he has since held. For several years no investigations were undertaken because the government authorities would not supply the means for equipping a laboratory for making them. In 1890 Prof. J. B. Johnson, of the Washington University in St. Louis, offered to co-operate with the Forestry Division, and those in charge of it were enabled to enter upon the mechanical tests in connection with the physical investigations going on at the laboratory in Washington. Since then the work has progressed by fits and starts, as best it could be forwarded with the limited facilities which were supplied by those who control appropriations for such purposes.

The investigations have been chiefly in relation to Southern timbers owing to the interest taken in that branch of the great subject by Southern railroad companies, and their willingness to carry material to be tested free of charge. Over 20,000 tests of Southern pines were made, and these were so thoroughly carried out that there does not now seem any reason why they need ever be tested again. Another series of tests of hardwoods and cypress have been made which, although not carried out in so extensive a scale as those on the Southern pines, will, nevertheless give a better index of the strength and qualities of these species than has ever been obtained before. These are now being put into form for publication.

The object of this work is not only to give more definite knowledge of the range of strength values of our timber, but more especially to establish rules of inspection which will enable a wood consumer to select his material with knowledge as to its behavior and quality. It will thus be seen that this information will be of immense value to all consumers of wood, and this includes nearly the whole community, but it especially commends itself to railroad companies, who are perhaps the largest consumers of wood in the country.

It is impossible in a short article like this to give anything like a complete idea of the scope of the work which has been laid out. It may be said, in the first place, that to give reliable information concerning the character of any species of timber it is essential to test and examine a large number of specimens of known origin, with information concerning the circumstances of their growth, so as to learn the causes of variation in their properties. It is expected by such a series of investigations to answer some of the following questions:

"What are the essential working properties of our various woods and by what circumstances are they influenced?

"How does age, rapidity of growth, time of felling and after treatment change quality in different timbers?

"In what relation does structure stand to quality?

"How far is weight a criterion of strength?

"What macroscopic or microscopic aids can be devised for determining quality from physical examination?

"What difference is there in wood of different parts of the tree?

"How far do climatic and soil condition influence quality?

"In what respect does tapping for turpentine affect quality of pine timber?"

A very complete system has been organized for collecting specimens and making the tests, the results of which have been published in the series of bulletins already referred to.

There has been difficulty in persuading the government authorities that this is a class of work which is appropriate for a Government office that is, that it has a sufficient general interest and value to the community to justify the expenditure of public money. As has been pointed out, such an investigation to have the value and scope which it should have, and to accomplish the results aimed at, requires that a very large number of tests be made, with careful consideration of all the attending data. This necessarily involves considerable expenditure. A bill to appropriate $40,000 for these tests has been in Congress for several sessions without action. The money expended in making these investigations has been largely derived from the general funds appropriated to the Forestry Division of the Department of Agriculture, but there is now a disposition to abandon the work unless favorable action can be obtained on the bill referred to above. Those interested in the subject—and this includes nearly all engineers, railroad managers, and especially master car builders, architects, etc.—may aid in securing the legislation required to continue the investigation by writing to their Congressman commending the work of the Forestry Division and urging action on the appropriation required to continue and complete the investigation and tests. It would be a public misfortune if these investigations were not continued and if the thorough work of Mr. Fernow was left incomplete.

Notes.

In the April number of the *Stevens Indicator* Mr. Wm. Kent has an article on the heating value of the volatile portion of bituminous coal, in which he urges the need of data obtained from actual tests, and outlines a series of experiments which he thinks would add greatly to the available knowledge on this subject. He then says: Two questions upon which the proposed research may throw some light are: (1) What is the character of the volatile matter of the more highly bituminous coals; and (2) may it not be commercially practicable to get rid of the least valuable portion of this volatile matter, by some kind of coking process, at the coal mines, and save freight not only upon it, but also on so much of the fixed carbon which is wasted in the ordinary boiler furnace in the operation of distilling the volatile matter? If any of the Western coals containing high percentages of oxygen contain it in such chemical combination that it can be removed at a comparatively low temperature at the coal mine, it would appear that a partial coking of these coals at the mine would be commercially practicable. Even if the oxygen cannot be removed except at a high temperature, it may be found that it carries with it in distillation the valuable by-products which are obtained in the Otto-Hoffman and the Semet-Solvay coking processes, and that their extensive introduction in the West would pay. There is a possibility of fractional distillation of Western coals giving three valuable products, first, gas approximating in composition to natural gas or methane, CH_4, which could be utilized in factories within a certain distance; second, ammoniacal tar waters, containing valuable substances for use as fertilizers or in the chemical industries; third, smokeless coal or coke, which would be the final solution of the smoke problem in the Western cities.

An official trial has also recently been made of the Belleville boilers constructed by Messrs. Maudsley Sons & Field, at their works in Greenwich, for the new twin screw steamer *Kherson*, built for the Russian volunteer fleet. The following were the conclusions drawn therefrom:

"During the first three hours the evaporation was equa- to 9.2 pounds of water per pound of coal burned, and for the first six hours 9 pounds of water. At the end of the sixth hour the fires were cleaned out, and again at the end of the tenth hour, and no allowance was made in the weight of coals. The mean results, it will be seen, are 8.88 pounds owafter evaporated per pound of coal, and 21.43 pounds of coal burned per square foot of grate area."

An account of some interesting researches on the value of paints for ironwork, made by Prof. J. Spennrath, has recently been published in the *Deutsches Bauzeitung*. As one result of these, Professor Spennrath concludes that none of the metallic oxides commonly used combine chemically with linseed oil. The drying process depends exclusively on an absorption of oxygen by the oil, which is facilitated by the presence of the pigment in a purely mechanical way. The value of the different pigments used varies. Thus, zinc white, when used for outside work, rapidly swells to double its previous volume, owing to the absorption of carbonic acid gas and water. Sulphuretted hydrogen will cause red or white lead to act in a similar way, but, when pure, Professor Spennrath considers these two latter pigments satisfactory. Carbon paints are very stable, as is heavy spar, but the covering power of the latter is small. In order to test the relative durability of various paints, sheets of zinc were coated with a number of different kinds. The zinc was then dissolved away by acid, leaving a film of paint. All these films, it was found, could be destroyed by the action of dilute nitric or hydrochloric acids, while the vapors of sulphuric and acetic acids acted similarly. Alkaline fluids and gases also destroyed the paints rapidly. Pure water was found to be more injurious than salt water, and hence the destructive action of sea water is to be attributed mainly to the mechanical effects of wash. Hot water was found to act more rapidly than cold. The most important discovery made was, however, the great influence of temperature. Films, similar to those already described, completely lost their elasticity and became brittle when exposed to a temperature of 208 degrees Fahrenheit. There was, at the same time, a large contraction. Similar effects are produced by prolonged exposure to considerably lower temperatures. Blistering he finds to be due to the inner coat

of paint being so thick that it has not hardened thoroughly before the second coat is applied.—*Practical Engineer.*

The elevation of the tracks of the Pennsylvania road through Newark, N. J., will involve an expenditure of $3,000,000, and will require about five years to finish the work. The elevation will be about four miles long, and where it crosses the Passaic River a four-track bridge will be erected. The elevated tracks will be on a bank. The average depression of the streets will be about 5 feet, and the average elevation of the tracks about 15 feet. The plans for the work are complete.

The Pennsylvania Railroad has contracted for two new ferryboats for service on its Twenty-third street ferry. This new ferry, about to be established, is much longer than the present ones, and to reduce the time of the trip the new boats will be faster than any now in the service of the company. They are to be capable of making 15 miles per hour. This speed has necessitated more powerful engines, and they present some novel features. The boats are to be 206 feet long over all and 65 feet beam, and will have two decks, being in these respects identical with the company's standard boats. They will be propelled by twin screws at each end (or four screws in all), each shaft being driven by a set of compound condensing engines, with one 20-inch high-pressure cylinder and two 32-inch low-pressure cylinders, all of 24-inch stroke. The three cylinders will be connected to cranks 120 degrees apart. Steam will be furnished by Ward water-tube boilers under assisted draft of ½-inch of water. The steam pressure is to be 150 pounds per square inch. The boats are to be fitted with steam steering gear, lighted by electricity and heated by the indirect system, the fans for which will be driven by electric motors. Many of our readers are familiar with the screw ferryboats in service on the Hudson River, in which the engines drive a shaft extending the whole length of the boat and having a screw at each end. The new boats have practically the same type of machinery, but it is doubled, so as to get the increased propelling power without great draft. One of the boats is to be built at the Cramp shipyards and the other by Chas. Hillman Shipbuilding Company.

In maintaining high speeds over long distances it is important to reduce the number of stops and the length of each stop to a minimum. Stops at water stations are among the most lengthy, and it is a wonder that means for taking water more quickly do not receive more attention. The Chicago & Northwestern road has realized the importance of this matter and has put in several new water-station outfits, in which 10-inch or 12-inch standpipes are used. All valves and connections are equally large, and as a result it has been found that water from a 50,000-gallon tank set 23 feet above the ground can be delivered through a 12-inch stand-pipe 300 feet away at the rate of 4,000 gallons per minute; and through a 10-inch stand-pipe located 800 feet away and connected to the tank by a 12-inch main at the rate of 3,200 gallons per minute. We understand that tank stops, at which over 3,000 gallons were taken, have been made in which the train got away inside of three minutes, as against the five to seven minutes ordinarily consumed. In this case time is saved to every train taking water at the station by an expenditure that we venture to state is less per minute of time saved than can be effected in any other way.

Hopper Gondola Car of 60,000 Pounds Capacity.—Central Railroad of New Jersey.

Through the courtesy of Mr. C. A. Thompson, Superintendent of Motive Power of the Central Railroad of New Jersey, we publish herewith the drawings of that company's latest hopper car of 60,000 pounds capacity. The car is 30 feet long outside of the end planking, 8 feet 11 inches wide outside the planks and the sides are 3 feet 11 inches high. The total length of the car over the dead blocks is 33 feet 2 inches and the width over the sills 8 feet 11 inches.

The frame consists of four continuous sills, the center sills being 5 inches by 9 inches in section and the side sills 5 inches by 12 inches. At the beginning of the hopper there are transverse blocks 5 inches by 9 inches in section, fitted between the center and side sills, and from these to the end sills there are short stringers. Directly in line with the dead blocks are "bumper braces" extending from the end sills to the body bolsters. An interesting feature of this supplemental framing is the use of pocket castings at their ends. In Fig. 2 we give one of these castings in detail. They are of cast iron, and, being fitted to the face of one timber and receiving the end of another, they take the place of mortises and tenons, and facilitate the removal of those timbers in repairs. The 5-inch by 9-inch "bridge blocks," to which the hopper doors are hinged, are also framed to the sills by the aid of these pocket castings. From a point just back of the draft gear and extending almost to the center of the car, the space between the center sills is filled in solid by a timber 9¼ inches by 9 inches in section.

The hoppers are supported by heavy wrought iron straps that extend across the sloping bottom and up the inclined sides to the side sills where they are firmly bolted. The hopper doors are held by a mechanism that is entirely un-

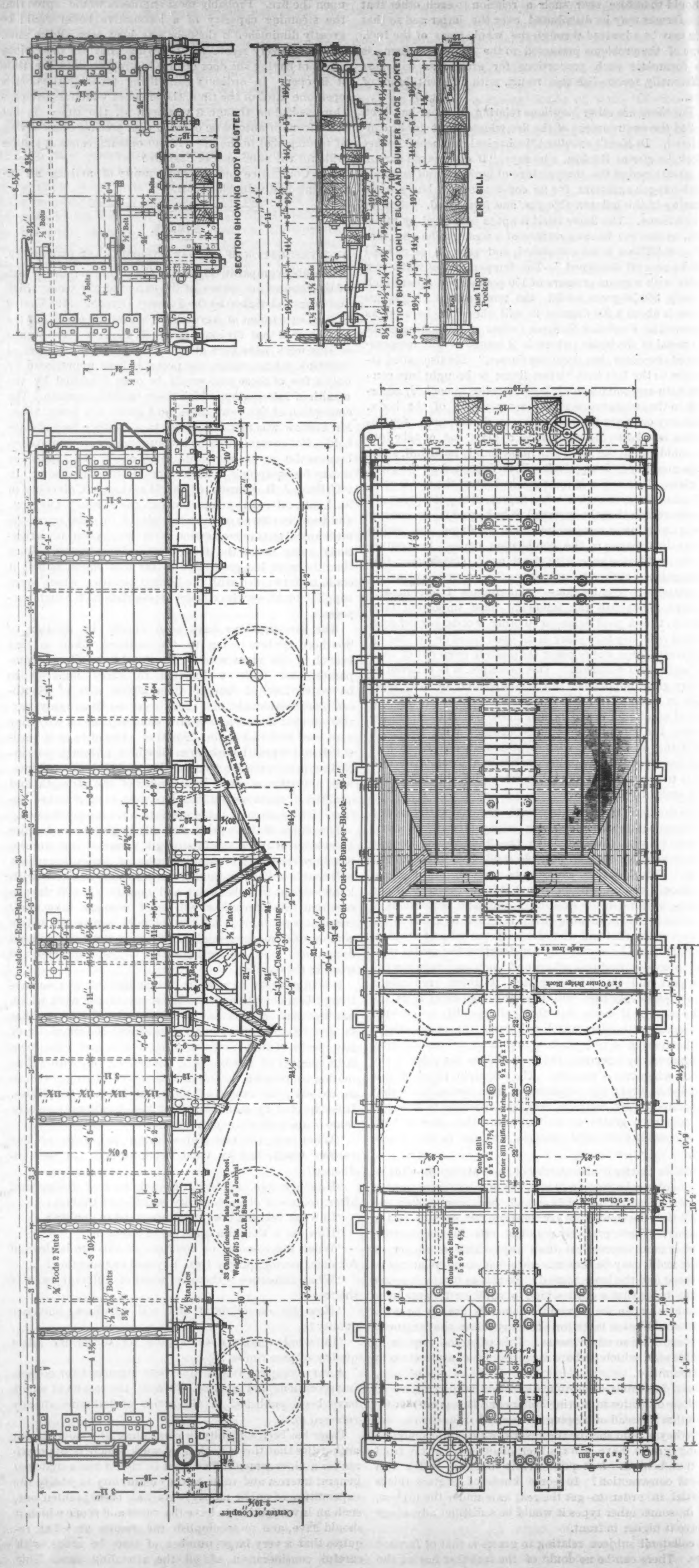


FIG. 1. HOPPER GONDOLA CAR OF 60,000 POUNDS CAPACITY.—CENTRAL RAILROAD OF NEW JERSEY.

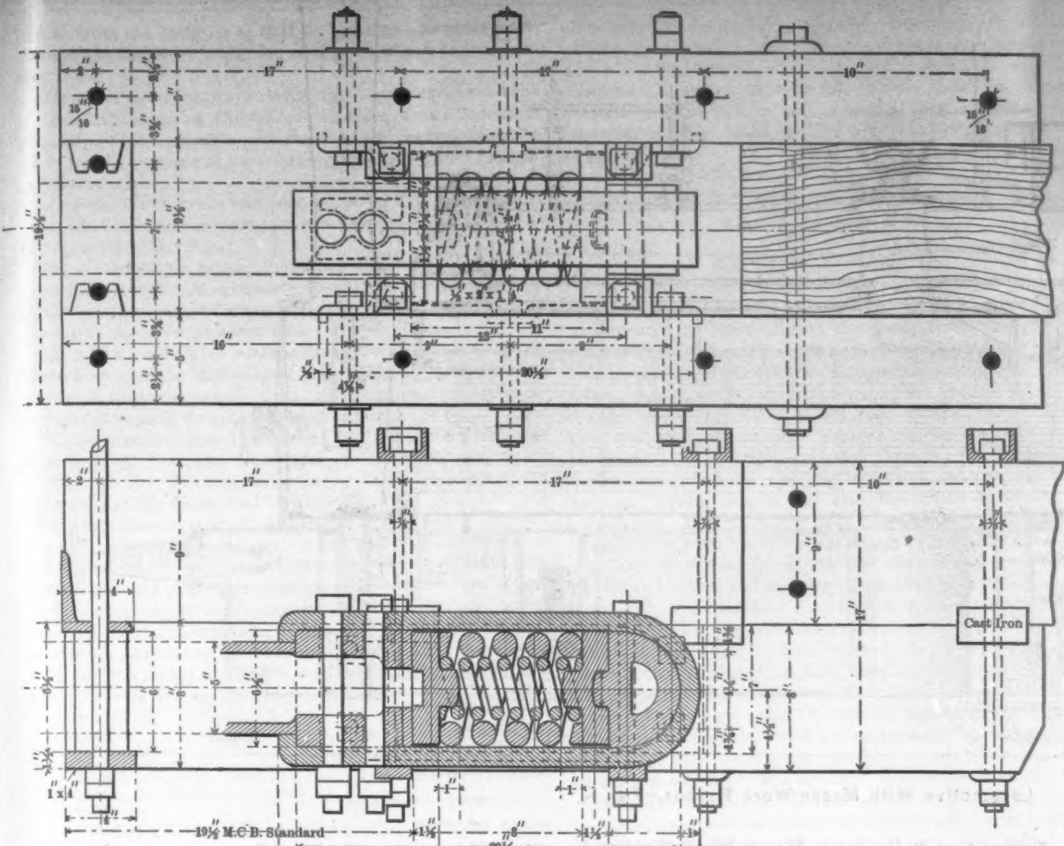


Fig. 3. Draft Rigging for 60,000-Pounds Gondola Car.

der the floor and between the doors, and is free from all danger of sticking. It consists of a toggle which is held down by cams on a shaft carried in the plate shown extending down from the side sill. This shaft is locked by a suitable pawl and gravity dog.

The presence of hoppers makes it impossible to use more than two truss rods, but these two are of liberal dimensions, being 1¼ inches in diameter with 1½-inch ends. They have been given a deep camber.

The draft rigging is of the Schoen pressed steel type and is illustrated in Fig. 3. The stops, it will be seen, are in

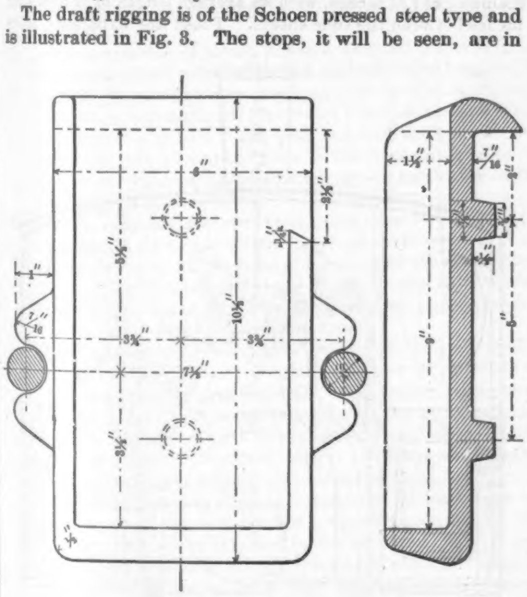


Fig. 2. Pocket Castings.

one piece of pressed steel on each timber and are set in at the center and bent over at the ends to mortise into the timber. They are each secured by six bolts. The drawbar strap is Mr. Thompson's design and is made semi-circular at the inner end and a cast-iron block fitted between it and the follower. This makes a stronger strap than the common construction. A 4-inch angle iron is fitted into the face of the end sill to take the impact of the bracket of the coupler.

The body-bolsters are composed of 10-inch by 1 inch top plates and 10-inch by 1½-inch bottom plates. The depth at the center is 6¼ inches. The ends of the top plates are bent over the ends of the lower plates, and it will also be seen from the section in Fig. 1 that the truss rod saddle castings are interposed between the ends of the bolsters and the side sills.

The car is carried on Fox pressed steel trucks, air-brakes and M. C. B. type of couplers.

FIG. 1. HOPPER GONDOLA CAR OF 60,000 POUNDS CAPACITY.—CENTRAL RAILROAD OF NEW JERSEY.

The St. Louis Convention of the American Society of Mechanical Engineers.

The American Society of Mechanical Engineers will hold its semi-annual convention at St. Louis, Mo., May 19 to 22, 1896. The headquarters of the society and its place for holding sessions will be at the Southern Hotel. The list of professional papers to be read at this session is as follows:

KEEP, WILLIAM J.: Strength of Cast Iron.
KENT, WILLIAM: The Efficiency of a Steam Boiler. What is It?
ELDRIDGE, A. H.: Tests of a Four-Cylinder Triple-Expansion Engine and Boiler.
HALE, R. S.: Determining Moisture in Coal.
KETTELL, CHARLES W.: A Study of the Proper Method of Determining the Strength of Pump Cylinders.
GOSS, W. F. M.: The Effect upon Diagrams of Long Pipe Connections for Steam Engine Indicators.
CARPENTER, R. C.: A New Form of Calorimeter.
HOFFMAN, J. D.: A Hydraulic Dynamometer.
HENDERSON, GEORGE R.: Spring Tables.
WHITHAM, JAY M.: Effect of Retarders in Fire Tubes of Steam Boilers.
WHITHAM, JAY M.: Experiments with Mechanical Stokers.
THURSTON, R. H.: Superheated Steam.
BRYAN, WILLIAM H.: Western River Steamers.
ALBERGER, L. R.: A Self-Cooling Condenser.
PORTER, H. F. J.: Hollow Steel Forgings.
HUTTON, F. R.: A Classification and Catalogue System for an Engineering Library.
MURRAY, THOMAS E.: A Steel Plate Fly-Wheel.

The social features of the programme and the excursions planned give promise of much enjoyment and profit.

The National Convention of Railroad Commissioners.

The eighth annual convention of Railroad Commissioners will be held at the office of the Interstate Commerce Commission, No. 1317 F street (Sun Building), in the city of Washington, D. C., on Tuesday, May 19, 1896, at 11 o'clock in the forenoon. The Railroad Commissioners of all States, and State officers charged with any duty in the supervision of railroads, are requested to attend and participate in the discussion of such topics as may come before the convention. The Association of American Railway Accounting Officers is also invited to attend, or send delegates to the convention, and join in the consideration of such questions of special interest to their association as may arise.

At the last convention committees were appointed on the following subjects and directed to report to the next convention:

1. Railway statistics.
2. Uniform classification.
3. Legislation.
4. Protection of public interests during railway labor contests.
5. Regulation of State and Interstate electric railways.
6. Powers, duties and actual work accomplished by the several State Railroad Commissions during the year.
7. Government control and government regulation of railways.
8. Safety appliances.
9. Pooling of freights and division of earnings.

The following resolution was adopted at the last meeting: "That a committee of five be appointed to select officers for and subjects to be presented at the next annual convention of this association, to solicit papers upon the same, either from members of the association or from those not connected with the organization, and to prepare, as far as possible, a programme of proceedings;" and the following committee on organization and programme for the next convention was named: George M. Woodruff, of Connecticut; G. G. Jordan of Georgia; Ira B. Mills, of Minnesota; E. C. Beddingfield, of North Carolina; Edward A. Moseley, Secretary of the Interstate Commerce Commission.

Members of former conventions are entitled to participate in the discussion of subjects at the coming meeting. The various State Commissions should be represented by full boards, as far as possible, and to that end all Railroad Commissioners are earnestly requested to attend the coming meeting.

Personal.

Mr. Julian R. Lane has been appointed General Manager of the Macon & Birmingham Railway.

Mr. N. E. Matthews has been appointed Purchasing Agent of the Ohio Southern, vice C. H. Roser.

Mr. John T. Clark has been appointed Master Mechanic of the Northern Ohio, with headquarters at Delphos, O.

Mr. C. H. Barnes has been appointed Division Master Mechanic of the Boston & Albany at West Springfield, Mass.

Mr. Howard James has been appointed Purchasing Agent of the Eastern Railway of Minnesota, with offices at Duluth.

Mr. Alfred Atwood has been appointed Locomotive Superintendent of the Mexican Railway to succeed Mr. E. G. Evens, resigned.

Mr. Wm. H. Taft, for some time past Acting Superintendent of Motive Power of the Boston & Albany, has been appointed Superintendent of Motive Power.

Charles H. Burnett has been appointed Purchasing Agent of the St. Lawrence & Adirondac Railway, with office at No. 51 East Forty-fourth street, New York.

Mr. W. W. Finlay has resigned the Third Vice-Presidency of the Southern Railway, and it is said he will take a position of responsibility on the Great Northern.

Major Edward Leslie, whose name is well-known to railroad men through the rotary snow plow that bears his name, died suddenly at Paterson, N. J., March 26.

During the absence of President Samuel Spencer in Europe, Mr. A. S. Andrews, of Raleigh, N. C., First Vice-president of the Southern Railway, will act as President of the company.

Mr. Thomas B. Purves, Jr., Master Mechanic of the Boston & Albany Railroad, has been appointed Superintendent of Rolling Stock, and will have charge of both the car and locomotive departments. His headquarters are in Boston, Mass.

Mr. David B. Carse, General Manager of Greenlee Bros. & Co., Chicago, manufacturers of wood working machinery, has returned from a three months' trip in Europe, where he visited railroad shops and car works.

Mr. T. D. Kline, who was reported as having accepted the general management of the Interoceanic Railway of Mexico, has declined the position, and there is no truth in the report that he is to resign as General Superintendent of the Central of Georgia.

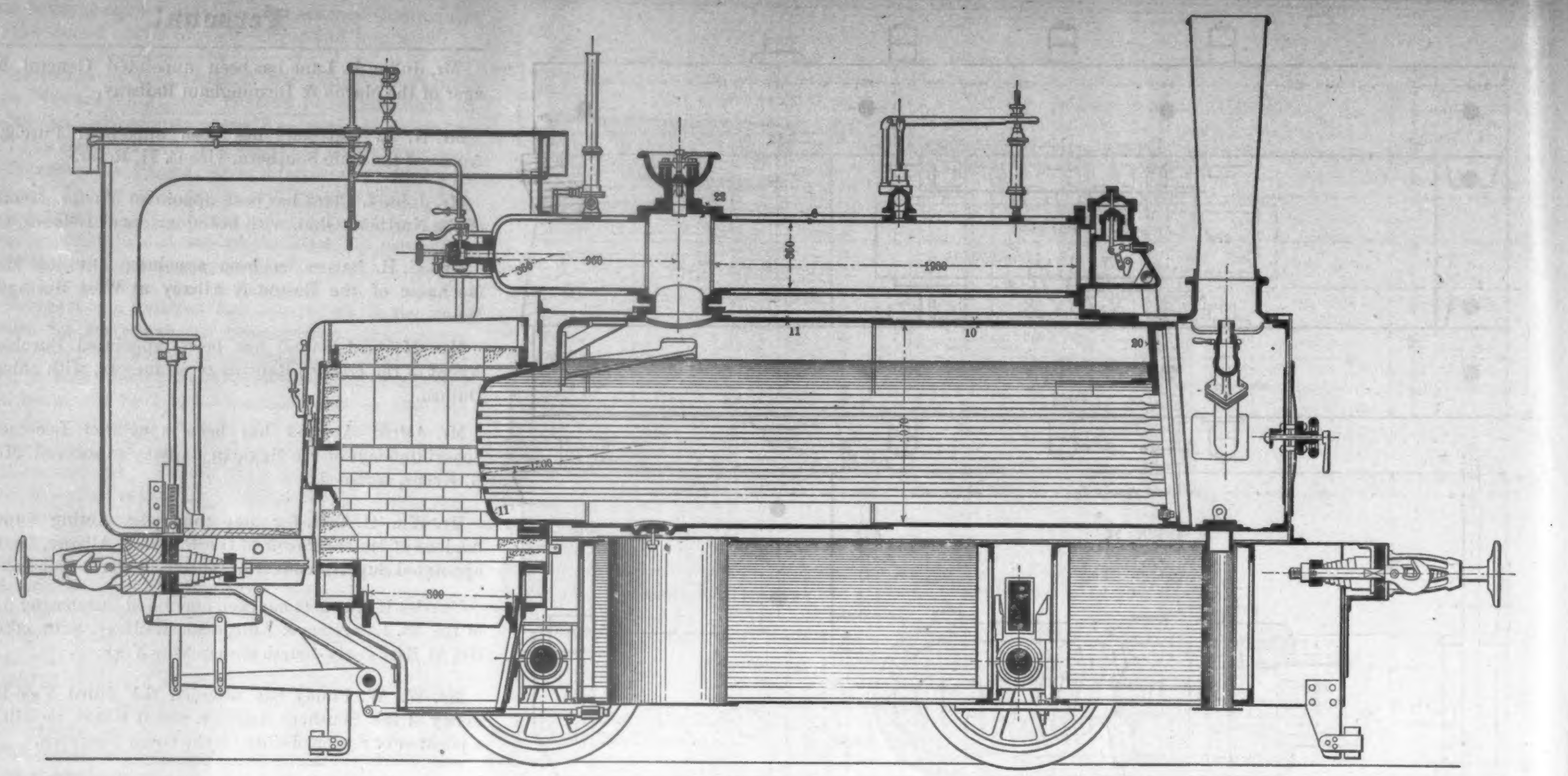
Mr. F. W. Morse, for some years Division Master Mechanic of the Wabash Railroad, with headquarters at Fort Wayne, Ind., has been appointed Superintendent of Motive Power of the Grand Trunk road. He succeeds Mr. Herbert Wallis, who has resigned from that position, which he held since 1873.

Mr. George T. Anderson, late Superintendent of the Indiana Car and Foundry Company, has been appointed Superintendent of the Chicago, New York & Boston Refrigerator Company, vice F. W. Brazier, lately appointed General Foreman of the car department of the Illinois Central. Mr. Anderson has charge of all the line cars, as well as the shops at Fifty-first street, Chicago.

Mr. C. M. Higginson, after many years of service on the Chicago, Burlington & Quincy, has gone to the Atchison, Topeka & Santa Fe as assistant to the President. Mr. Higginson has done much on the Burlington system to establish uniformity and economical co-operation between different departments. He is a civil engineer and has had experience also in the locomotive and accounting departments, and is well fitted in ability and experience to fill the position to which he has been called.

Mr. James S. Drake, General Superintendent of the New Jersey & New York Railroad, died at his home at Hillsdale, N. J., on April 16. Mr. Drake began railroad service as apprentice on the Grand Trunk 40 years ago. He was afterward Master Mechanic of the Portland & Rochester road in Maine. Later he occupied a similar position on the New York Elevated Railroad, and in 1879 went to the New Jersey & New York as Master Mechanic. In 1880 he was appointed Superintendent also, and for some years has given all his time to the latter office.

Mr. Robert Miller, General Superintendent of the Michigan Central, is hereafter to be Superintendent of Motive Power and Equipment. Mr. R. H. L'Hommedieu, former Assistant General Superintendent, becomes Mr. Miller's successor as General Superintendent. Mr. Miller's first position on the Michigan Central road was as Master Car Builder, with charge also of buildings and waterworks, which position he occupied for eight years. In 1884 he was transferred to the transportation department, becoming in that year Assistant General Superintendent, and holding the office six years. In taking this new posi-



Locomotive With Mason-Work Firebox.—Fig. 1.

tion he therefore returns to a line of work in which he was engaged for years.

Mr. Herbert Wallis has resigned from the position of Mechanical Superintendent of the Grand Trunk, after a service of 23 years in that capacity. Mr. Wallis received his early mechanical training at the Derby shops of the Midland Railway. In 1866 he became foreman in its Bradford shops, and in 1871 accepted the position of Assistant Mechanical Superintendent of the Grand Trunk Railway. In 1873 he was placed at the head of the department. As illustrating the growth of the business since Mr. Wallis has been Mechanical Superintendent, it is stated that the road's locomotive equipment has grown from 353 to 808 engines, its passenger cars from 352 to 916, and its freight car equipment from 6,078 cars to 23,383 cars. Because of tariff restrictions, the road has manufactured many of its supplies that under other conditions would have been purchased, and a large variety of work has therefore been under his care. Mr. Wallis is highly esteemed in railroad and engineering circles. He was recently elected president of the Canadian Society of Civil Engineers.

Mr. Charles E. Smart, General Master Mechanic of the Michigan Central, died at his home in Jackson, Mich., on March 29, after a short illness. Mr. Smart had been General Master Mechanic of the Michigan Central since 1885. He was born at Rochester, N. H., in 1840, and after serving as machinist apprentice in the East, went into the railroad shops at Niles, Mich. In 1860 he went to Vicksburg, Miss., working on the railroad between Vicksburg and Jackson, and shortly afterward went to Cuba in charge of the machinery on a sugar plantation. He returned to the United States, and in 1863 worked for a short time in the Quincy shops of the C., B. & Q. R. R. After another short period spent in Cuba he accepted the position of foreman of the South Bend Iron Works, where he remained until 1872, when he became a locomotive engineer on the Missouri, Iowa & Nebraska road. In 1874 he went to the Michigan Central as a locomotive engineer, and a year later became Master Mechanic of the Mackinaw Division in charge of the locomotive and car departments. That office he held for 10 years, when he became General Master Mechanic of the road.

The Butler & Pittsburg Railway Company was organized in the offices of the Carnegie Steel Company April 24th. J. T. O'Dell, of Boston, was chosen President. Andrew Carnegie and T. M. Carnegie, Jr., are directors. The Secretary was authorized to at once advertise for bids for construction of track and road bed. When completed the new road will be merged into the Pittsburgh, Shenango & Lake Erie Railroad. The Carnegie Steel Company guarantees the road at least three million tons of ore a year.

The contract for building the new passenger station at Providence, R. I., together with the office and express buildings on either side of the station, has been let to Hortons & Hemmenway, of Providence, for $425,000. The contractors expect to begin work immediately, and are under obligation to have the buildings under roof by Jan. 1. The basements of the three structures will be built of Leete's Island granite, and the walls will be of buff brick with sandstone trimmings. The floors of the waiting-rooms and corridors will be marble in mosaic patterns, and the woodwork will be of quartered oak. The inside walls will be of enameled tile.

Locomotive Boiler with Mason-Work Firebox.*

BY A. SOCHER, CHIEF ENGINEER OF THE ROYAL AUSTRIAN STATE RAILWAY IN LARBACH.

In designing the locomotive boiler illustrated by Figs. 1 and 2, the first and main object that was kept constantly in view was to obtain the greatest possible safety against explosion.

That the boiler with a stayed firebox, built upon the Stephenson designs, is only partially satisfactory in this respect will be readily acknowledged. Even if the locomotive boiler does not occupy a prominent place in the statistics of boiler explosions, it is simply that we have the conditions under which it works to thank, for railroad officials exercise the most painstaking oversight and most careful inspection in connection with their boilers as being a matter of the utmost importance to themselves. In spite of this, however, bad water, sulphurous coal, etc., give many unpleasant surprises to boiler inspectors. Hence, there is no doubt but that there is an actual and pressing necessity for a safer construction of locomotive boilers.

Noteworthy efforts have been made of late years in this direction without as yet having fully satisfied all of the conditions of this exceedingly difficult problem. The reason for this may lie in the fact that the designs which have been brought out follow too closely the common type of boiler, by which a comparatively satisfactory reconstruction of the existing boiler becomes possible, but it will be confined between limits that are cramped and well defined as to the form which it shall assume.

From the following description it will be seen whether, or to what extent, this boiler is an improvement in form over the one that has just been denounced, and which is the prevailing type of the day.

The construction of locomotive No. 8822 of the Royal Austrian State Railway was completed and the engine put into service in April, 1894.

The construction of the boiler is exceedingly simple. The shell or barrel of the boiler ending in a smokebox, and the front tubesheet, are worthy of no particular attention. The stayed portion of the boiler has been entirely discarded. In its stead a cone-shaped drum is used that projects into the furnace, into the front side of which the tubes open. This drum is placed, so far as the products of combustion are concerned, entirely below the water level. The bottom line of the cone-shaped projection is straight, while at the top it curves over the double angle of the cone.

A straight steam collecting drum or tube is used instead of a steam drum, into which the steam flows through a hollow connection that is placed above the point where the most rapid generation takes place. At the back end there are the cab connections, on top are the safety valves, while the throttle is placed at the front.

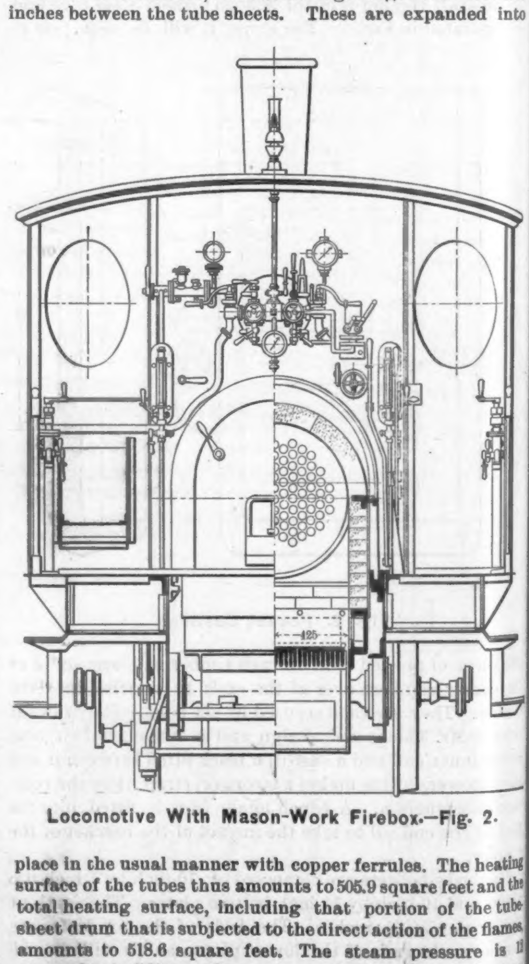
To this peculiar boiler the masonry firebox is added. This is closed at the top by a semicircular arch, which encloses the tubesheet drum already described. The arch rests upon brackets on either side and is independent of the remaining portion of the brickwork, which is locked to the sides of the firebox by special plates. The brickwork of the side and back walls of the firebox rest upon a cast iron frame that has an opening on the inside which is closed against the fire itself by iron plates. At the front end, two rows of bricks project out far enough to protect the bottom of the tubesheet drum from the direct action of the impinging flames.

The back wall rests upon a rectangular fire frame, and is closed by a sliding door whose vertical motion is controlled by a movable guide, both guide and slide being balanced by a counterweight. There is nothing novel in the arrangement of the grates, ashpan, clampers and the sheet-iron casing over the firebox.

The expansion of the boiler has no effect upon the firebox since the latter is not connected to the shell, but is fastened by itself upon its own frame. This arrangement has given n trouble at all.

The boiler was built at the machine shops of the Alpine Mountain Company (*Alpinen Montangesellschaft*) at Klagenfurt in 1893. The sheets are made of Martin basic steel from the Herkunst Works in Styria.

The two portions of the barrel are each riveted on the longitudinal seam, and the same is done with both portions of the steam drum; the shaped piece on the latter consisting of crucible cast steel. The mean inside diameter of the barrel is 3 feet 6.91 inches, with a thickness of .43 inch. The front tube sheet has a thickness of .79 inch and the back .43 inch; into these there are placed 99 rolled Mannesmann tubes, having an inside diameter of 1.61 inches, and an outside diameter of 1.81 inches, with an average length of 12 feet 1.27 inches between the tube sheets. These are expanded into



Locomotive With Mason-Work Firebox.—Fig. 2.

place in the usual manner with copper ferrules. The heating surface of the tubes thus amounts to 505.9 square feet and the total heating surface, including that portion of the tube sheet drum that is subjected to the direct action of the flames amounts to 518.6 square feet. The steam pressure is 1[illegible] atmospheres (180 pounds per square inch). The boiler wa[s] built into the locomotive No. 8822, that has a tender, unde[r] the direction of the designers. The principal dimensions a[s] compared with those of an ordinary boiler are as follows:

Boiler.	New.	Ordinary.
Diameter of barrel	3 feet 6.91 inches	3 feet 6.91 inches
Number of tubes	99	99
Diameter of tubes outside	1.81 inches	2.20 inches
" " " inside	1.61 "	1.81 "
Length " "	12 feet 1.27 "	10 feet 9.92 "
Heating surface in tubes	505.9 square feet	481.4 square feet
Total heating surface	518.6 " "	525.3 " "
Steam pressure	180 pounds	180 pounds

After a number of tests both with and without loads, i[n] all of which satisfactory results were obtained, the locomo[-] tive was placed in regular service in April, 1894, and ra[n] along with six sister locomotives doing the same work

* Translated from the *Organ für die Fortschritte des Eisenbahnwesens.*

remote from the designer so that he could not possibly have exerted any influence upon the results obtained in this service work.

After a service of seven months the locomotive was sent to the main shops at Knittelfeld, in order that a thorough inspection of the outside and inside of the boiler might be made for the purpose of ascertaining whether it had experienced any injury.

After the steam drum had been removed it was possible to enter the boiler and inspect it to the remotest corner without removing the tubes.

The sheets of the boiler, including the tubesheet drum, showed an even coating of scale over the whole surface to a thickness of about .04 inch, and this extended up to about the top of the average water line.

Since the coating of scale showed small cracks, and as there were none at the angles where the three stays connected, it is safe to conclude that the boiler was subjected to a slight change of form that was detrimental to it.

In the steam drum two flange bolts were broken; the reason being that the front end of the tube was bolted solidly to the throttle chamber. Later measurements showed that the drum had expanded by the heat .2 inches more than the corresponding portion of the boiler between the two points of attachment. After making an allowance for the necessary play, the locomotive was put back into service without any improvement being made in the boiler. In the brickwork of the firebox no improvement was necessary. A partial change was first made after it had been in service for 13 months. According to the results of the service as given in a report of a year's work in comparison with the sister locomotives we have the following:

Locomotive.	New.	Total of six ordinary.
Mileage	25,405.5	149,535.1
Gross loads hauled	1,907,920 tons	11,235,655 tons
Consumption of coal per mile	31.6 pounds	35.76 pounds
Consumption of coal per 1,000 gross ton miles	678.0 "	786.00 "

This shows a saving n oal consumption in favor of experimental boiler, both in locomotive mileage and 1,000 ton miles, of about 11⅓ per cent.

This saving is not an inconsiderable matter in itself, but it should also be taken into consideration that this was obtained almost entirely with a low-priced brown coal whose theoretical calorific power only amounted to 12,220 heat units, which of itself was not at all favorable to a better showing.

OBSERVATIONS IN SERVICE.

The generation of steam from a perfectly cold boiler required, as was anticipated, from a half to three-quarters of an hour more time than with the ordinary boiler, while, on the other hand, after being housed it would retain its pressure for twelve hours, so that during this period the locomotive could be placed under a full head of steam in a few minutes.

The generation of steam is rapid and the water level can be kept at a high point while the boiler is being forced to the utmost. That this is the case is proven by the fact that investigation showed from the water line indicated on the inside of the boiler that it had been run with the glass entirely filled. In this connection there is the very remarkable fact to be borne in mind that there was never any water carried over into the cylinders.

The arrangement of the steam drum must be considered as a fortunate one and one tending to collect steam that is dry. The application of this form of construction to the ordinary locomotive boiler instead of the uncomely and wide opening in the barrel for the dangerous vertical steam dome, is therefore certainly worthy of consideration.

The tubes are of the ordinary thickness, but an application of a thicker tube for staying purposes to the outer circle could be made to advantage. The bellied form of the tubesheet cannot be recommended for further application because the expanding of the tubes, especially those farthest from the center, is rendered difficult, and they are troublesome to keep tight except by constant calking.

On sultry summer days the radiation of heat from the firebox, especially from the back, was very oppressive. This difficulty was effectively met by the introduction of a brisk current of air in between the brickwork and the casing, but coupled with a loss of heat that was not an insignificant one.

The manner in which, upon a further application of this new form of boiler, the radiation is to be checked as much as possible, while, at the same time, the action of the fire is to be increased, will be developed in a future communication.

The many promising results that have been obtained with this new form of boiler on the experimental locomotive have induced the management of the Royal Austrian State Railway to build a similar boiler for a special locomotive and also a larger one for a locomotive of series No. 88.

The first, which will be a six-wheel coupled passenger engine, will soon be built and is already well on its way toward completion.

It is clearly to be seen that the steam-producing efficiency of the perfectly water-cooled firebox will be raised by the increased evaporation induced by the greater length of tubes obtained by lengthening the tubesheet drum. The considerably higher temperature of the products of combustion at the start, due to the conditions under which the fire burns in this box lined with firebrick, requires that the tubes should be slightly longer in order that the temperature of the gases entering the smokebox shall not be too high.

It has been thoroughly well established by experiment that in the Stephenson type of boiler there is no advantage in using tubes longer than 15 feet 9 inches, as far as steam production is concerned.

With this new form of boiler this length, which is the greatest that is efficient at present, may be increased, and with it comes the possibility that locomotives, like those having eight wheels coupled, for example, which up to the present time carry a useless weight of long tubes in their boilers, may be equipped with boilers that are considerably more efficient as steam producers. Furthermore, the new boiler is particularly well adapted for use on locomotives where bad feed water must be used, and where coal that contains a high percentage of sulphur must be burned. Finally, the new new boiler can well be used on construction locomotives, since these are, for the most part, in the hands of careless men.

Third Annual Convention of the Association of Railroad Air-Brake Men.

(*Concluded from Page* 76.)

In the discussion the drain cup received a good share of attention, and a number of members found the only satisfactory way to clean it was to take it down entirely and remove the dirt either with steam or a lye bath. Mr. Farmer spoke on the defect card and advocated its use, as where brakes could not be repaired at the station where the defects where first noted, either from lack of time or facilities, the card would be a notification to parties further along the line to make the needed repairs. Mr. Fraser said that on the Southern Pacific they used blanks for reporting not only brake defects but also hot boxes and drawbars pulled out. Mr. Saunders said that on the Pennsylvania road blanks were used for reporting by inspectors and conductors. Both had to report and their reports were compared, and if they did not agree the man who failed to note a defect had to explain. Mr. Hawks, of the C. & A. Railway gave an interesting talk on maintenance, in the course of which he said that he had worked for the Alton over 40 years, and that he used to have a leather bag that contained all the tools he needed for repairs. Now, we must have test yards, racks, and many tools and appliances. Since he began his career in air-brake work, such advances have been made that now he has the sixth kind of triple, the sixth pump and the third kind of hose. He used cards and blank reports that are filled out and sent to him. The chairman, Mr. Brodnax, gave the results of some experiments in transmission of air through three-quarter-inch pipe half a mile long, with the idea of saving expense where the air had to be carried a long distance.

On the third day of the convention the report on "Main Reservoir and Connections" was read. The report is largely devoted to the location of the reservoir and to its volume. The location preferred is back of the cylinder saddle, between the frames. The other possible locations are under the moving board and under the foot plate. It should never be located on the tender if it is possible to avoid it. A large main reservoir is advocated for the following reasons:

1st. Less delay in getting train charged for testing.

2d. Increased safety through ability to quickly release and recharge after any application, whether for stops, holding down grades, terminal tests, break in two, bursted hose or emergency application caused by engineer or trainmen.

3d. Increased life of air-hose and air-pump, combined with greater efficiency of the latter, and also decreased wear and better performance of engineer's brake valve.

4th. Less liability for triple valve to delay in releasing, and consequently wheels to slide.

5th. Less moisture in triple valves and consequent freezing up in winter.

For reasons given in the foregoing the committee recommend:

1st. That the capacity of main reservoirs be made greater than now generally employed. Sixteen thousand cubic inches or over for passengers, and 20,000 cubic inches or over for freight.

2d. That where practicable, they be placed on engines and not on tender.

3d. That the air inlet and outlet be separated as far as possible, and the outlet be at the top of the reservoir.

4th. That but two connections to the main reservoir be made.

5th. That where possible, the pipes leading from pump to reservoir have a gradual incline for drainage toward the latter.

This report was not discussed at any great length and the one that followed, on "Train Signals," was not in type, but was read from the manuscript, and the members therefore were not able to discuss it.

The reports of committees having been disposed of, the remainder of the session was devoted to topical discussions and to election of officers, etc. Nashville was chosen as the place of meeting for 1897. The officers elected were as follows: President, S. D. Hutchins; First Vice-President, A. J. Cota; Second Vice-President, C. P. Cass; Third Vice-President, W. F. Brodnax; Secretary, P. M. Kilroy; Treasurer, Otto Best. Resolutions of thanks were passed to those who had extended courtesies to the association, including railroads that had furnished help to committees by giving them the facilities for carrying out experiments.

Experiments have, according to the *Improvement Bulletin*, recently been made by Mr. A. W. Haacke respecting the amount of heat lost by radiation through steam pipes. The tests were directed to determine the relative losses of heat from, first, bare pipes; second, pipes covered with 1 inch of insulating composition; and third, pipes covered with 1 inch of insulating composition and three layers of hair felt. The testing surfaces consisted of three cast-iron steam pipes of 5-inch external diameter, and 6 feet long, with blank flanges on each end. The pipes were supplied by steam that had been dried and so placed as to be subject to radiation and conduction under precisely similar conditions, one being bare and two others covered, as before mentioned. The results of the experiment are quite interesting. With steam at a pressure of from 45 pounds to 60 pounds, out of a possible loss of 100 per cent., as much as 83 per cent. is saved by a 1-inch covering of composition. If over this covering 1 inch and 1½ inches of hair felt with canvas is added, the extra saving is only 8½ per cent. If 1 pound of coal is required to evaporate 8 pounds of water into steam at 60 pounds pressure, then every square foot of uncovered steam-pipe wastes 6½ hundredweight of coal per year. At a higher pressure of steam, and in cold weather, this loss is even greater.

The Most Advantageous Dimensions for Locomotive Exhaust Pipes and Smoke Stacks.*

BY INSPECTOR TROSKE.

(*Continued from page* 47.)

C. COMPARISON OF THE DIFFERENT FORMS OF STACKS.

If we bring together the three forms of stacks that have been considered, their own diameters and that of their nozzles being the same, what has been said will be made clear. A reference to Plate II. and the related Table VII. brings this out.

The tables are full of information in many ways: First they show the slight rise in the course of the curves of cylindrical stacks over those of the conical, from which it again appears that those of the greatest flare have the highest curves. Up to a certain nozzle distance and with certain stack diameters the curves of the cylindrical stacks are the highest, while those with an inclination of one in six are the lowest, and those of the one in twelve stacks are between the two; then the first curve falls below that of the one in twelve stack, which also by a still further increase of the nozzle distance finally falls below that of the one in six stack. The larger the stack and the smaller the nozzle opening, just so much more striking do these differences become.

The tables belonging to Plate VII. give some information regarding this noteworthy phenomena. They include the nozzle distances corresponding to three forms of stacks which have produced the highest vacuums with the five nozzles. These distances are here calculated from the bottom of the stack in order to keep the figures smaller. We next see that the maximum is reached considerably earlier with the cylindrical stack than it is with the conical, and in these latter again the less they flare open at the top. The two conical forms of stack can furthermore develop the same maximum if the nozzle distance is correspondingly adjusted. In stacks with the smallest diameters of 14.76 inches for example a vacuum of 4.13 inches can be obtained with a nozzle diameter of 3.94 inches for the one in twelve stacks the nozzle distance from the bottom of the stack must be 1 foot 9.85 inches, for the one in six stacks this nozzle distance must be 2 feet 2.97 inches. In the same way with a cylindrical stack of 14.76 inches diameter we get a vacuum of only 0.2 inch less with a nozzle distance, measured from the bottom of the stack of 13.98 inches.

We see, further, from Table XIV., that the necessary nozzle distance for obtaining the highest vacuum with all forms of stacks increases the smaller the nozzle diameter

TABLE VII.—SHORTENED STACKS.

A.—Cylindrical Stacks.

1.—Stack Diameter = 14.76 inches.

Length of stack.		Nozzle Diameters in inches. 3.94	4.33	4.74	5.12	5.51
Full length	Beginning	3.70	4.04	4.37	4.45	4.45
	Maximum	3.94	4.26	4.57	4.65	4.57
Shortened 11.81 inches	Beginning	3.11	3.43	3.74	3.86	3 92
	Maximum	3.74	4.02	4.33	4.34	4.29
" 1 foot 8.87 inches	Beginning	2.52	2.81	3.11	3.27	3.41
	Maximum	3.56	3.83	4.10	4.13	4.13
" 2 feet 3.56 inches	Beginning	1.57	1.85	2.13	2.36	2.52
	Maximum	3.35	3.59	3.57	3.94	3.83
Total fall in the vacuum for the beginnings		2.13	2.19	2.24	2.09	1.93

2.—Stack Diameter = 15.75 inches.

Length of stack.		Nozzle Diameters in inches. 3.94	4.33	4.74	5.12	5.51
Full length	Beginning	3.43	3.76	4.09	4.23	4.29
	Maximum	3.74	4.06	4.37	4.51	4.45
Shortened 11.81 inches	Beginning	2.82	3.11	3.43	3.62	3.74
	Maximum	3.58	3.89	4.18	4.27	4.21
" 1 foot 8.87 inches	Beginning	2.20	2.48	2.78	3.02	3.19
	Maximum	3.44	3.74	4.03	4.13	4.02
" 2 feet 3.56 inches	Beginning	1.34	1.61	1.89	2.11	2.32
	Maximum	3.25	3.54	3.84	3.94	3.83
Total fall in the vacuum for the beginnings		2.09	2.15	2.20	2.12	1.87

NOTE.—The figures give the vacuum in inches of water at the beginning with a nozzle position of 1 ft. 6.9 in., and the maximum values obtained, whose corresponding nozzle location varies with the diameter of the stack.

3.—Stack Diameter = 16.73 inches.

Length of Stack.		Nozzle diameters in inches. 3.94	4.33	4.74	5.12	5.51
Full length	Beginning	3.11	3.45	3.78	3.94	4.04
	Maximum	3.50	3.84	4.13	4.29	4.33
Shortened 11.81 inches	Beginning	2 48	2.80	3.11	3.30	3.43
	Maximum	3.39	3.70	3.99	4.09	4.13
" 1 foot 8.87 inches	Beginning	1.89	2.17	2.46	2.68	2.83
	Maximum	3.27	3.52	3.90	3.96	3.94
" 2 feet 3.68 inches	Beginning	1.06	1.34	1.61	1.85	2.05
	Maximum	3.03	3.37	3.68	3.80	3.80
Total fall in the vacuum for the beginnings		2.05	2.11	2.17	2.09	1.99

4.—Stack Diameter = 17.72 inches.

Length of Stack.		Nozzle diameters in inches. 3.94	4.33	4.74	5.12	5.51
Full length	Beginning	2.80	3.11	3.45	3.62	3.74
	Maximum	3.25	3.56	3.90	4.06	4.09
Shortened 11.8 inches	Beginning	2.17	2.46	2.78	2.97	3.11
	Maximum	3.17	3.50	3.82	4.00	4.06
" 1 foot 8 inches	Beginning	1.57	1.83	2.11	2.32	2.48
	Maximum	3.05	3.39	3.72	3.90	3.98
" 2 feet 3.56 inches	Beginning	0.85	1.04	1.26	1.46	1.63
	Maximum	2.83	3.17	3.50	3.68	3.82
Total fall in the vacuum for the beginnings		1.95	2.07	2.19	2.16	2.11

* Paper read before the German Society of Mechanical Engineers, and published in *Glasers Annalen für Gewerbe und Bauwesen*.

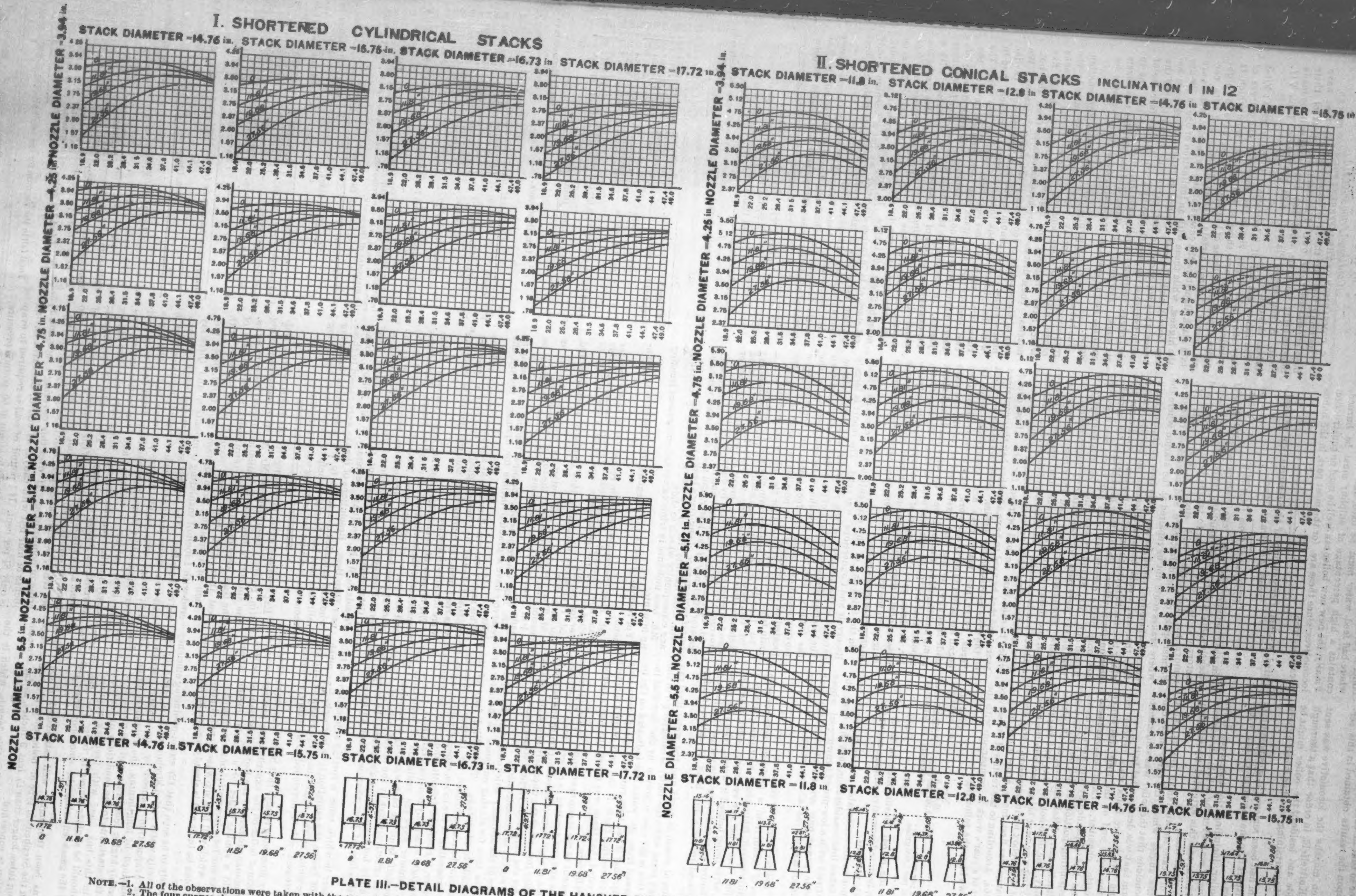


PLATE III.—DETAIL DIAGRAMS OF THE HANOVER SMOKESTACK AND EXHAUST NOZZLE EXPERIMENTS.

NOTE.—1. All of the observations were taken with the same steam pressure (3.94 in. of mercury) and with the same openings for the admission of air.
2. The four curves shown on each diagram are taken from the same points with the full-length stack and then shortened three times. The amount of the shortening (11.81 in., 19.68 in. and 27.56 in.) is marked above each curve.

TABLE VIII. B.—CONICAL STACKS WITH AN INCLINATION OF 1 IN 12.

1.—Stack Diameter = 11.81 inches.

Length of stack.		Nozzle diameters in inches. 3.94	4.33	4.74	5.12	5.51
Full length	Beginning	4.49	4.92	5.35	5.53	5.55
	Maximum	4.90	5.29	5.65	5.75	5.67
Shortened 11.81 inches	Beginning	3.86	4.23	4.63	4.78	4.82
	Maximum	4.49	4.86	5.12	5.15	5.04
" 1 foot 8.87 inches	Beginning	3.23	3.56	3.90	4.06	4.11
	Maximum	4.08	4.41	4.63	4.63	4.49
" 2 feet 3.56 inches	Beginning	2.40	2.72	3.03	3.19	3.29
	Maximum	3.64	3.90	4.00	3.96	3.86
Total fall in the vacuum for the beginnings.		2.09	2.20	2.32	2.34	2.26

2.—Stack diameter = 12.8 inches.

Length of stack.		Nozzle diameters in inches. 3.94	4.33	4.74	5.12	5.51
Full length	Beginning	4.08	4.49	4.96	5.15	5.24
	Maximum	4.63	5.03	5.41	5.49	5.43
Shortened 11.81 inches	Beginning	3.46	3.84	4.25	4.49	4.61
	Maximum	4.32	4.65	4.98	5.07	5.02
" 1 foot 8.87 inches	Beginning	2.85	3.19	3.58	3.82	3.98
	Maximum	4.02	4.31	4.53	4.63	4.61
" 2 feet 3.56 inches	Beginning	2.07	2.40	2.78	3.03	3.19
	Maximum	3.60	3.89	4.08	4.13	4.01
Total fall in the vacuum for the beginnings.		2.01	2.09	2.18	2.12	2.05

3.—Stack diameter = 14.76 inches.

Length of stack.		Nozzle diameter in inches. 3.94	4.33	4.74	5.12	5.51
Full length	Beginning	8.25	3.62	4.06	4.33	4.49
	Maximum	4.13	4.49	4.94	5.11	5.12
Shortened 11.81 inches	Beginning	2.66	3.02	3.39	3.66	3.86
	Maximum	3.88	4.22	4.59	4.75	4.78
" 1 foot 8.87 inches	Beginning	2.09	2.40	2.74	3.00	3.23
	Maximum	3.62	3.98	4.30	4.41	4.41
" 2 feet 3.56 inches	Beginning	1.42	1.69	1.99	2.22	2.44
	Maximum	3.39	3.64	3.90	4.04	3.98
Total fall in the vacuum for the beginnings.		1.83	1.93	2.07	2.11	2.05

4.—Stack diameter = 15.75 inches.

Length of stack.		Nozzle diameter in inches. 3.94	4.33	4.74	5.12	5.51
Full length	Beginning	2.82	3.17	3.58	3.86	4.06
	Maximum	3.78	4.13	4.55	4.74	4.74
Shortened 11.81 inches	Beginning	2.30	2.64	3.00	3.25	3.45
	Maximum	3.62	3.96	4.35	4.49	4.51
" 1 foot 8.87 inches	Beginning	1.81	2.11	2.40	2.64	2.85
	Maximum	3.46	3.78	4.13	4.27	4.30
" 2 feet 3.56 inches	Beginning	1.18	1.42	1.65	1.87	2.09
	Maximum	3.19	3.52	3.84	3.98	3.98
Total fall in the vacuum for the beginnings.		1.64	1.75	1.93	1.99	1.95

TABLE IX. C.—CONICAL STACKS WITH AN INCLINATION OF 1 IN 6.

1.—Stack Diameter = 11.81 inches.

Length of Stack.		Nozzle diameter in inches. 3.94	4.33	4.74	5.12	5.51
Full length	Beginning	3.84	4.31	4.88	5.15	5.32
	Maximum	4.98	5.35	5.73	5.87	5.80
Shortened 11.81 inches	Beginning	3.30	3.74	4.23	4.49	4.65
	Maximum	4.57	4.95	5.26	5.34	5.28
" 1 foot 8.87 inches	Beginning	2.80	3.19	3.62	3.86	4.02
	Maximum	4.21	4.55	4.80	4.86	4.78
" 2 feet 3.56 inches	Beginning	2.17	2.50	2.87	3.08	3.23
	Maximum	3.76	4.02	4.15	4.17	4.09
Total fall in the vacuum for the beginnings.		1.67	1.81	2.01	2.07	2.09

2.—Stack Diameter = 12.8 inches.

Length of Stack.		Nozzle diameter in inches. 3.94	4.33	4.74	5.12	5.51
Full length	Beginning	3.43	3.86	4.37	4.69	4.92
	Maximum	4.65	5.06	5.41	5.49	5.59
Shortened 11.81 inches	Beginning	2.89	3.29	3.76	4.06	4.27
	Maximum	4.38	4.74	5.03	5.19	5.15
" 1 foot 8.87 inches	Beginning	2.40	2.76	3.19	3.40	3.66
	Maximum	4.06	4.42	4.71	4.86	4.79
" 2 feet 3.56 inches	Beginning	1.79	2.13	2.52	2.76	2.92
	Maximum	3.67	4.00	4.26	4.33	4.25
Total fall in the vacuum for the beginnings.		1.64	1.73	1.85	1.93	1.97

3.—Stack Diameter = 14.76 inches.

Length of stack.		Nozzle diameter in inches. 3.94	4.33	4.74	5.12	5.51
Full length	Beginning	2.58	2.95	3.37	3.70	3.96
	Maximum	4.12	4.53	4.92	5.10	5.14
Shortened 11.81 inches	Beginning	2.13	2.46	2.83	3.13	3.39
	Maximum	3.88	4.27	4.61	4.76	4.79
" 1 foot 8.87 inches	Beginning	1.69	2.00	2.34	2.66	2.87
	Maximum	3.64	4.03	4.33	4.45	4.47
" 2 feet 3.56 inches	Beginning	1.18	1.44	1.73	1.97	2.20
	Maximum	3.35	3.68	3.98	4.06	4.06
Total fall in the vacuum for the beginnings.		1.40	1.51	1.64	1.73	1.76

4.—Stack Diameter = 15.75 inches.

Length of Stack.		Nozzle diameter in inches. 3.94	4.33	4.74	5.12	5.51
Full length	Beginning	2.15	2.48	2.85	3.17	3.41
	Maximum	3.78	4.15	4.57	4.74	4.80
Shortened 11.81 inches	Beginning	1.77	2.07	2.40	2.68	2.89
	Maximum	3.58	3.96	4.35	4.49	4.57
" 1 foot 8.87 inches	Beginning	1.40	1.67	1.97	2.20	2.42
	Maximum	3.43	3.78	4.13	4.29	4.33
" 2 feet 3.56 inches	Beginning	.96	1.18	1.44	1.65	1.87
	Maximum	3.19	3.54	3.86	4.06	4.06
Total fall in the vacuum for the beginnings.		1.19	1.30	1.41	1.52	1.54

the steam pressure remaining the same. Thus, for example, suppose the nozzle diameter drops from 5.51 inches to 3.94 inches the amount of steam delivered falls to about one-half and the nozzle distance, measured from the bottom of the stack, with a diameter of 14.76 inches, increases as follows:

Cylindrical stack from 10.04 inches to 13.98 inches.
One in twelve " " 17.92 " " 21.85 "
" " six " " 23.43 " " 26.97 "

Thus in all three cases the variation is about the same, or 3.94 inches. This increase of the nozzle position shows that, according to Section VIII., the stream of steam issuing from a small nozzle under otherwise equal conditions forms a smaller cone than that issuing from a larger one, so that with the same location of the nozzle the full section of the stack is filled later, which means that it is filled at a greater distance from the nozzle opening. Finally, Table VII. also shows that, with the nozzle in the same position and within the limits recommended above for practical work, the cylindrical stack produces the highest vacuum, its diameter being equal to that of the waist of the others, yet with the sharpest taper, as well as with the least, the vacuum produced can be equalized, provided that the nozzle diameter is properly proportioned to the stack diameter.

IV.—EXPERIMENTS IN THE SHORTENED STACKS.

The experiments with the 15 stacks heretofore discussed were now extended, so that the whole series was repeated with stacks shortened an equal amount, as follows:

1. By a shortening of 11.42 inches.
2. By additional shortening of 7.87 inches.
3. " " " " 7.87 "

} Total, 27.16 inches.

All of the shortened stacks were tested with the e nozzles under the same conditions as before. The results obtained for each of the three forms of stack are given in Table X. and XI., and for the two nozzle positions in the accompanying Tables VII. to IX.

As a first result of the shortening of the stack there was a very noticeable diminution of the vacuum produced. This reduction was not in an exact ratio to the amount of shortening, but was somewhat greater, as will be seen from table X.

For each inch of shortening in the above table the vacuum falls about as given in table XI.

We see that this fall in the vacuum is considerably more for the cylindrical stacks than it is for the conical ones; and for the latter the loss is the greater as the opening at the top is narrower.

Thus we find a skillfully demonstrated refutation of the proposition erroneously stated by Zenner, that the height of the stack has a very subordinate influence upon the action of the blast nozzle.

This is shown still more clearly in Fig. 36. It gives the fall in the vacuum, with cylindrical stacks having a diameter of 17.72 inches and an original length of 7 feet 4.6 inches, or five times the diameter, that are gradually shortened to nothing. The three curves show the vacuums produced with nozzle openings of 3.94 inches, 4.74 inches and 5.51 inches. Their co-ordinates were obtained on the experimental apparatus under the same conditions as the rest o the data.

TABLE X.

Exhaust Nozzle. Diameter.	Reduction of vacuum in inches as the result of a further shortening of the cylindrical and conical stacks by 15.75 inches, with a nozzle location of 18.9 inches below the bottom of the same.								
	Shortened 11.81 in.			Shortened 19.68 in.			Shortened 27.56 in.		
Inches.	Cyl.	1/12	1/6	Cyl.	1/12	1/6	Cyl.	1/12	1/6
3.94	0.61	0.51	0.37	1.22	1.00	0.75	2.09	1.63	1.18
4.33	0.65	0.53	0.41	1.28	1.06	0.81	2.15	1.75	1.30
4.74	0.67	0.59	0.45	1.32	1.18	0.89	2.20	1.93	1.42
5.12	0.61	0.61	0.49	1.22	1.22	0.96	2.13	1.98	1.52
5.51	0.55	0.61	0.51	1.10	1.20	0.98	1.97	1.97	1.54

TABLE XI.

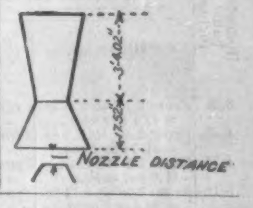
Total Shortening.	Cylindrical.	Conical, 1/12.	Conical, 1/6.
11.81 inches.	0.0523 inch.	0.0483 inch.	0.0378 inch.
19.68 "	0.0624 "	0.0585 "	0.0446 "
27.56 "	0.0765 "	0.0672 "	0.0517 "

TABLE XIV.—COMPARISON OF THE HIGHEST INDICATED VACUUMS AND THE CORRESPONDING DISTANCES OF THE EXHAUST NOZZLES FROM THE LOWER ENDS OF STACKS OF EQUAL DIAMETERS.

(a) Full Length Stacks.

Diam.	Shape.	3.94 in. Vacuum.	3.94 in. Nozzle Location.	4.33 in. Vacuum.	4.33 in. Nozzle Location.	4.74 in. Vacuum.	4.74 in. Nozzle Location.	5.12 in. Vacuum.	5.12 in. Nozzle Location.	5.51 in. Vacuum.	5.51 in. Nozzle Location.
Inches.		Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.
13.78	Cylindrical..	4.04	8.86	4.29	8.47	4.59	6.89	4.61	5.32	4.53	1.57
	Conical 1/12...	4.37	18.70	4.78	18.31	5.14	17.13	5.28	15.55	5.28	13.00
	" 1/6...	4.33	23.43	4.77	23.04	5.15	21.85	5.32	20.67	5.37	19.29
14.76	Cylindrical..	3.94	13.98	4.26	13.78	4.57	13.00	4.65	12.21	4.57	10.04
	Conical 1/12...	4.13	21.85	4.49	21.65	4.94	20.87	5.11	20.08	5.12	17.92
	" 1/6...	4.12	26.97	4.53	26.38	4.92	25.79	5.10	25.00	5.14	23.43
15.75	Cylindrical..	3.74	18.70	4.06	18.70	4.37	17.13	4.51	16.34	4.45	12.40
	Conical 1/12...	3.78	25.00	4.13	25.00	4.55	24.21	4.74	19.49	4.74	21.06
	" 1/6...	3.78	30.51	4.15	30.51	4.57	29.73	4.74	28.94	4.80	26.58

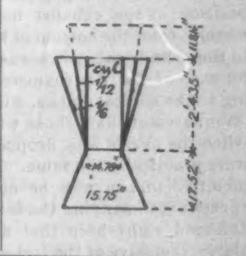
1. The vacuums given are the maxima produced with a steam pressure of 100 mm. (3.94 in.) of mercury. 2. The corresponding nozzle locations here indicate the distances from the top of the nozzle to the bottom of the stack, at which the highest vacuums were obtained. 3. In order to get the distance from the nozzle to the narrowest portion (the waist) of the stack we must add 17.52 in. to the amount given in the tables.



(b) Stacks Shortened 11.81 Inches (300 mm.).

Diam.	Shape.	3.94 in. Vacuum.	3.94 in. Nozzle Location.	4.33 in. Vacuum.	4.33 in. Nozzle Location.	4.74 in. Vacuum.	4.74 in. Nozzle Location.	5.12 in. Vacuum.	5.12 in. Nozzle Location.	5.51 in. Vacuum.	5.51 in. Nozzle Location.
Inches.		Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.
14.76	Cylindrical..	3.74	19.10	4.02	18.70	4.33	17.72	4.34	15.55	4.29	13.98
	Conical 1/12...	3.88	24.02	4.22	23.62	4.59	22.64	4.75	21.26	4.78	20.28
	" 1/6...	3.88	28.35	4.27	28.35	4.61	27.36	4.76	26.38	4.79	25.40
15.75	Cylindrical..	3.58	23.43	3.89	21.85	4.18	21.26	4.27	20.28	4.21	16.54
	Conical 1/12...	3.62	29.73	3.96	28.15	4.35	27.56	4.49	26.58	4.51	21.41
	" 1/6...	3.58	31.30	3.96	31.30	4.35	30.71	4.49	30.32	4.57	28.15

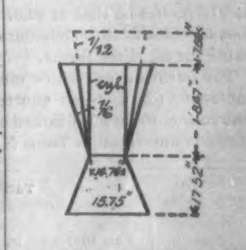
The stack of 13.78 in. diameter was not shortened.



(c) Stacks Shortened 19.68 in. (500 mm.)

Diam.	Shape.	3.94 in. Vacuum.	3.94 in. Nozzle Location.	4.33 in. Vacuum.	4.33 in. Nozzle Location.	4.74 in. Vacuum.	4.74 in. Nozzle Location.	5.12 in. Vacuum.	5.12 in. Nozzle Location.	5.51 in. Vacuum.	5.51 in. Nozzle Location.
Inches.		Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.
14.76.	Cylindrical..	3.56	22.44	3.83	22.25	4.11	20.87	4.13	20.28	4.08	18.31
	Conical 1/12...	3.62	26.38	3.98	26.18	4.30	24.80	4.41	24.21	4.41	22.64
	" 1/6...	3.64	30.32	4.04	30.32	4.33	28.74	4.45	28.15	4.47	26.58
15.75.	Cylindrical..	3.45	31.30	3.74	28.15	4.04	26.58	4.13	23.43	4.02	20.28
	Conical 1/12...	3.46	31.30	3.78	31.30	4.13	30.32	4.27	29.73	4.30	28.15
	" 1/6...	3.43	31.30	3.78	31.30	4.13	31.30	4.29	31.30	4.33	29.73

The stack of 13.78 in. diameter was not shortened.



(d) Stacks Shortened 27.56 in. (700 mm.)

Diam.	Shape.	3.94 in. Vacuum.	3.94 in. Nozzle Location.	4.03 in. Vacuum.	4.03 in. Nozzle Location.	4.74 in. Vacuum.	4.74 in. Nozzle Location.	5.12 in. Vacuum.	5.12 in. Nozzle Location.	5.51 in. Vacuum.	5.51 in. Nozzle Location.
Inches.		Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.
14.76.	Cylindrical..	3.35	29.73	3.59	28.15	3.81	25.79	3.94	25.00	3.83	22.84
	Conical 1/12...	3.39	31.30	3.64	30.51	3.90	28.94	4.04	25.00	3.98	25.79
	" 1/6...	3.35	31.30	3.68	31.30	3.98	29.73	4.06	29.73	4.06	28.35
15.75.	Cylindrical..	3.25	31.30	3.54	31.30	3.84	31.30	3.94	29.73	3.84	26.58
	Conical 1/12...	3.19	31.30	3.52	31.30	3.84	31.30	3.98	31.30	3.98	31.30
	" 1/6...	3.19	31.30	3.54	31.30	3.86	31.30	4.06	31.30	4.06	31.30

The stack of 13.78 in. diame was not shortened.

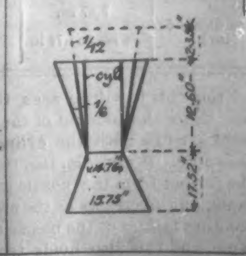
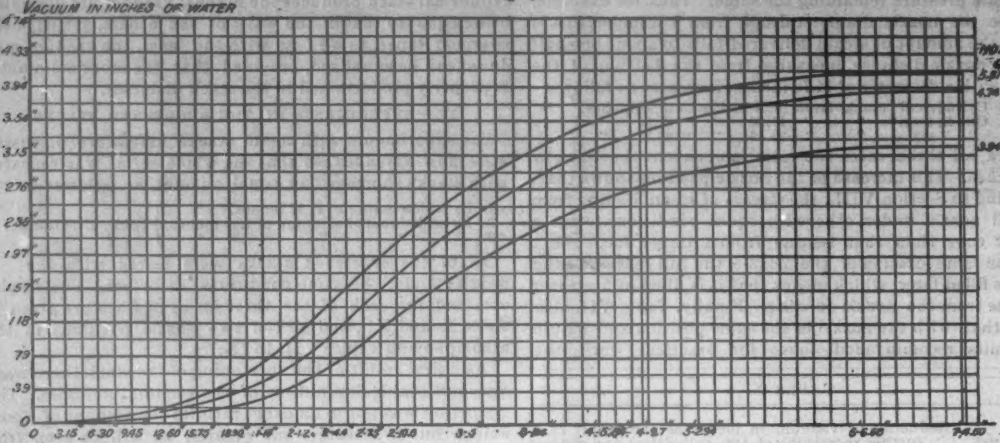


Fig 36



From this diagram we see that the highest vacuum was obtained with a stack length of 6 feet 7.53 inches, which is about 4.7 times the diameter, that it falls rapidly with the decreasing length until at 2 feet 7.5 inches it begins to drop more slowly, and gradually dies away at the zero point. We see, therefore, that with stacks having a length of from 2 feet 6 inches to 2 feet 11 inches, measured from the nozzle opening, or a length equal to about twice the diameter, air comes in from above and that this influx increases as the length decreases. The current of steam with its surrounding mantel of air no longer fills the whole sectional area of the stack, and consequently the external air can be drawn into the apparatus. The same phenomenon was also observed by Zenner and Prüsmann.

From tables X. and XI. it also follows that the same vacuum can be obtained with different lengths of stacks having the same diameters if the position of the nozzle is properly adjusted.

The shorter the actual stack, by just so much must the position of the nozzle be lowered if the vacuum is to remain the same, and the longer the stack, the higher must the nozzle be placed.

The great influence that a lowering of the nozzle has upon the vacuum, especially when the stack has been shortened, is clearly shown in Table XII.

TABLE XII.

Diameter of exhaust nozzle, inches.	Increase of the vacuum for a stack 15.75 inches in diameter, that had been shortened 19.68 inches as above, when the position of the exhaust nozzle is dropped from 19.68 inches to 39.37 inches below the bottom, the total height thus remaining unchanged.		
	Cylindrical.	Conical, $\frac{1}{12}$ inclination.	Conical, $\frac{1}{8}$ inclination.
3.94	From 2.28 to 3.37 in. = 47.4 per cent.	From 1.89 to 2.95 in. = 75.0 per cent.	From 1.48 to 3.15 in. = 116 per cent.
4.33	From 2.56 to 3.7 in. = 44.6 per cent.	From 2.19 to 3.62 in. = 65.7 per cent.	From 1.77 to 3.50 in. = 97.7 per cent.
4.74	From 2.83 to 4 in. = 41.0 per cent.	From 2.48 to 4.03 in. = 62.3 per cent.	From 2.05 to 3.88 in. = 88.4 per cent.
5.12	From 3.08 to 4.13 in. = 34.6 per cent.	From 2 72 to 4.17 in. = 53.6 per cent.	From 2.30 to 4.07 in. = 76.9 per cent.
5.51	From 3.25 to 4.02 in. = 23.6 per cent.	From 2.93 to 4.25 in. = 45.0 per cent.	From 2.52 to 4.21 in. = 67.1 per cent.

It is worthy of noting just here that where the foregoing position of the exhaust nozzle was 19.68 inches (500 millimeters) from the bottom of the stack, the vacuum belonging to the cylindrical stacks was almost exactly .8 inch higher for each of the five diameters of nozzles than that belonging to the conical stacks, with an inclination of $\frac{1}{8}$, and abou .35 in. greater than those with an inclination of $\frac{1}{12}$; while when the nozzle was dropped to 39.37 inches the vacuume were practically the same. The same difference of from .35 inch to .8 in. can also be observed in the diagrams of the curves accompanying the text. It should be thoroughly understood right here that all the text relating to the six plates, inclusive of the technical portions, was first compiled after the latter had been entirely completed.

The correspondence of the vacuum with the nozzle at a distance of 39.37 inches which has been mentioned, is probably due to the fact that the stack will be filled with the curren of steam in its smallest cross-section when the nozzle stands at 27.5 inches so that at 39.37 inches it (1,000 mm.), taking the loss of velocity into consideration, the vacuums will be the same for all three forms.

The question as to how much the nozzle distance must be increased for a given shortening of the stack, if the same vacuum is to be maintained as belonging to the unshortened stack is answered in Table XIII.

TABLE XIII.

Shape of Stack.	The increase in the nozzel distance required for maintaining a constant vacuum, when the stack is shortened by		
	11.81 in.	19.68 in.	27.56 in.
Cylindrical	12.60 in.	18.90 in. to 20 in.	27.5 to 28 in. (with diameters of 17.75 in. only or more.
Conical $\frac{1}{12}$ incl.	7.87 in.	13.00 in.	18.9 in.
Conical $\frac{1}{8}$ incl.	3.94 in. to 4.74 in.	7.87 in.	12.6 in.

From this it will be seen that the increase of distance is less than the amount of the shortening with the conical stacks, while with the cylindrical stacks it remains about the same. It appears, too, that the total working height of the former from the nozzle to the top of the stack is not the same, but decreases as the stack is shortened by the corresponding failure of the nozzle distance to keep pace with the same, and this also holds true the wider the opening at the top. For example, suppose a conical stack with an inclination of $\frac{1}{8}$ to be shortened at the top 3.94 inches (100 mm.), the corresponding increase of nozzle distance would be about 1.6 inches, while for a stack having an inclination of $\frac{1}{12}$ it would be about 2.6 inches.

It is an interesting conclusion to be drawn from tables X. and XI. that, as shown by table XIV. which follows, it is possible to maintain the same maximum vacuum with different shapes and lengths of stacks by merely changing the position of the exhaust nozzle.

(To be Continued.)

Trade Catalogues.

[In 1894 the Master Car-Builders' Association, for convenience in the filing and preservation of pamphlets, catalogues, specifications, etc., adopted a number of standard sizes. These are given here in order that the size of the publications of this kind, which are noticed under this head, may be compared with the standards, and it may be known whether they conform thereto.

It seems very desirable that all trade catalogues published should conform to the standard sizes adopted by the Master Car Builders' Association, and therefore in noticing catalogues hereafter it will be stated in brackets whether they are or are not of one of the standard sizes.]

STANDARDS.

For postal-card circulars	3½ inches by 6¼ inches.
Pamphlets and trade catalogues	3½ inches by 6 inches. 6 inches by 9 inches. 9 inches by 12 inches.
Specifications and letter-paper	8½ inches by 10¾ inches.

THE "CLEVAUC" STEAM SPECIALTIES. *The Clarence E. Van Auken Co., 166-174 South Clinton street, Chicago, Ill.* 40 pages, 6 inches by 9 inches.

The specialties illustrated in this catalogue bear the stamp of originality combined with neatness and simplicity of design. The company say their line of steam specialties is larger and more complete than that of any other concern, and the catalogue certainly shows an extensive line of these goods. The first illustration is of a safety water column, the alarm valve of which is worked by buckets instead of floats. These are always full of water and are in no danger of collapse. Then follow regulators for high and low pressures, noiseless back-pressure valves for either horizontal or vertical pipes, pump governors for elevator and water works pumps, house pump governors, air compressor governors, automatic receiving tanks and governors for modern heating systems, damper regulators, temperature regulators, syphon automatic air valves, high and low pressure steam traps and other devices. The most approved methods of applying some of these mechanisms are illustrated by diagrams. The steam traps mentioned are constructed on a new principle, giving continuous discharge, and operating without pressure in the trap. The cover can be removed while it is in operation without shutting off the pressure. Some of these traps are operating in plants carrying 225 pounds pressure.

The catalogue is embellished by numerous full-page illustrations of notable buildings in which the Clevauc specialties are in use.

ILLUSTRATIONS OF THE SPECIAL LINE OF MACHINE TOOLS, *For Working Iron and Steel Plates, Bars and Structural Shapes.* Built by Hilles & Jones Company, Wilmington, Del., 32 pages, 8½ by 12 inches.

This publication was evidently intended to be of the standard size of 9 by 12, but the binder has trimmed it a quarter of an inch too small in one direction. It consists as its title implies of illustrations only, without any descriptive matter relating to the machines represented. The engravings are mostly of the half tone variety. These represent a number of heavy shearing and punching machines, plate planers, beam coping and straightening machines, bending rolls and a milling machine. The illustrations in the latter part are very good wood engravings, and are generally very fair, but some of them would have been improved if the machines had been a little more carefully painted before they were photographed.

The illustration on page 10 is an example, some of the cast iron of which looks as though it was suffering from a cutaneous eruption. In view of the importance of photography to the mercantile department of mechanical engineering, it may be expected that in the near future, a photographing room, provided with the best light and other accessories for producing good pictures will be required in every first class establishment.

THE STANDARD WATER TUBE SAFETY BOILER. *The Standard Boiler Company, Marquette Building, Chicago, Ill.* 16 pages, 6¾ by 9¼ inches. (Not standard size.)

This pamphlet gives first an isometrical view of one of their boilers, with part of the brick work removed, and then a longitudinal section in outline. After this what is called a "description" of the boiler is given, but which is in reality only assertions of its advantages. The criticism which should be made here is that if the publishers had given a fuller and clearer description of their boiler, so that the reader could get a clear idea of its construction that then the vaunting of its merits, would produce a much greater impression than it now does. It should be remembered in writing such literature, that nine readers out of ten, are absolutely ignorant of the construction of the objects described. The first thing to do then—and generally the first thing the reader wants to know—is how is it made? and how does it work? After he understands this, then it is in order to boast of its merits. To illustrate what we mean—something is said about the tubes of the boiler being expanded in the wrought stee headers, but there is no description of these "headers," and although they may, and probably do, have all the merits claimed for them, yet a person about to buy a boiler before doing so would certainly want to know more about them than the makers have told us in the publication which is here reviewed. The rule to be observed is to describe first as fully and as clearly as possible, and then boast, brag and hustle afterwards.

Perspective views of a 4,000 horse-power installment of these boilers, for the North Chicago Railway; two others, showing "headers" and drums, ready for shipment; an outside view of a power station; other engravings, showing a boiler front, the inside of the works and a sectional view of the building of the Second Avenue Traction Company of Pittsburgh, Pa., are given. Lists of users of these boilers, and testimonials of their merits are also added.

"THE NORWALK" AIR AND GAS COMPRESSOR. *Manufactured by the Norwalk Iron Works Company, South Norwalk, Conn.*, 106 pages, 7 by 9¾ inches. (Not standard size.)

The extended use of compressed air for so many purposes gives especial interest at the present time to a catalogue devoted to machinery of this class. Interest, too, is greatly increased when the subject is treated as well as it is in the publication before us, and which is evidence of the fact to which we have often called attention, that the best literature relating to many subjects is now found in catalogues of this kind.

The extent and the variety of uses to which compressed air is now used is indicated by the following observations in the introduction to this book. It is there said: "Old uses (of compressed air) have been extended; abandoned plans have been revived and economically carried out; many new processes, using compressors, have been developed, and experimenters are still busily engaged in further extending the uses of compressed air. We have been called upon to develop heat, and to produce cold; to move air with a force hardly greater than the breath of a child, and to blow a shot from a cannon; to lift tons of iron, and to clean a watch; to steer a vessel and to launch the torpedo to destroy her."

The book begins with a general introduction of the subject, which is followed by illustrations of eight different patterns of compressors, which have been successively developed. A brief description of their points of difference is given, but would have been more satisfactory if it had been made fuller and had been illustrated with sectional views. Twelve pages are then devoted to a description of the principles and the construction of the "Norwalk Compressors," which is illustrated by another drawing of one of them with some of the internal parts represented by dotted lines. A chapter on the capacity of these machines is followed by very good engravings and descriptions of the different patterns and types which are made. There are in all 26 different air compressors and six gas compressors illustrated. Besides these there are three special compressors shown which are intended for charging pneumatic locomotives, several forms of the latter being also shown.

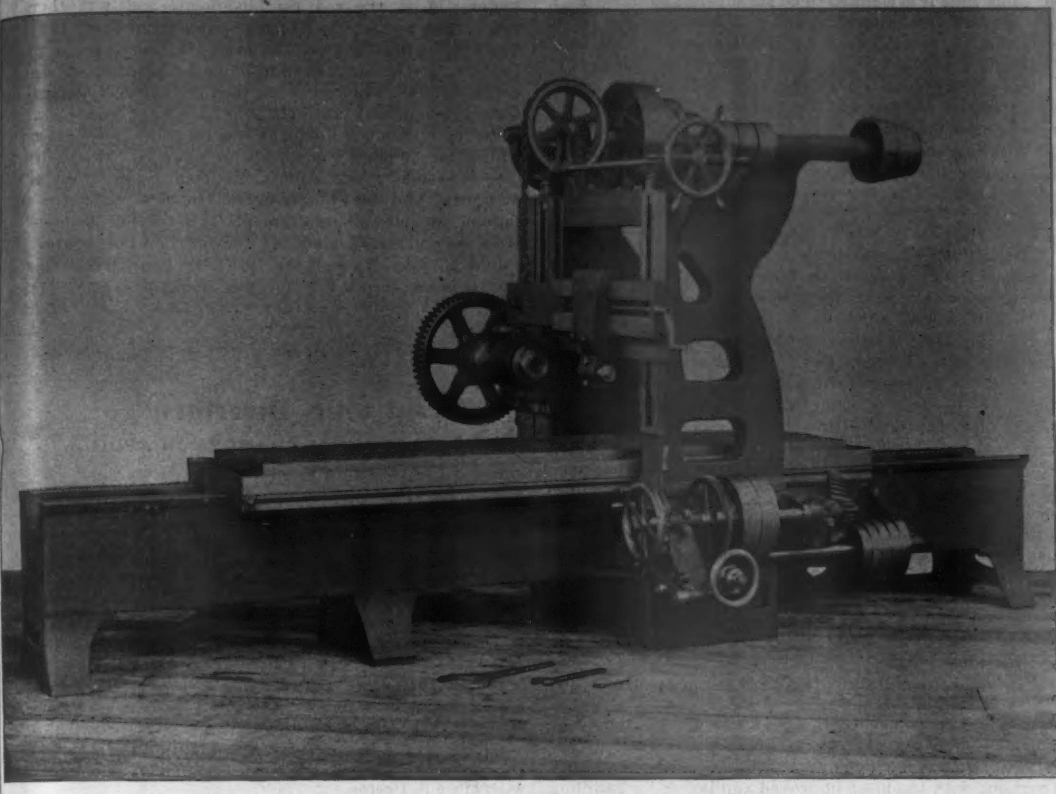
A view of Captain Glassford's army balloon, which was inflated with hydrogen gas that was compressed in steel tanks by one of these machines, is given, and also one of the dynamite cruiser *Vesuvius* whose guns are operated by air compressed by a Norwalk machine to a pressure of 5,000 pounds per square inch. There is also an engraving of a compressor for the monitor *Terror*, on which compressed air is used for many purposes as a substitute for steam in places remote from the boilers, or when exhaust steam would be a menace to health and safety.

A disappearing gun and carriage erected at the entrance of New York harbor is also shown, which is loaded, moved into position and aimed by compressed air. At the end of the book a number of special forms of compressors—some with oscillating cylinders and others placed vertically—are shown. The catalogue ends with an essay on the efficiency of compressed air engines, another on the requirements of rock drills and a very good index.

The book is well printed on good paper and the engravings are excellent. The only criticism for which there seems to be any ground is that it is not a standard size and the cover has a sort of gay and frisky style hardly consistent with the sober character of the subject and the contents of the book.

RULES. Darling, Brown & Sharp, Providence, R. I. 12 pages. 3 by 5¼ inches. (Not standard size.)

The purpose of this little catalogue is to describe the well-known steel rules made by this company. It is also announced that they now make "tempered rules" as accurately graduated as the Standard, or soft, rules are. The catalogue contains engravings and tables of sizes, etc., of this company's products.



Milling Machine for Horizontal and Vertical Milling.

Milling Machine for Horizontal and Vertical Milling.

Most of the milling operations in which our readers are interested are heavy enough to require a machine of more than ordinary strength, and it may be truly said that if milling tools are to supplant the planer to any great extent they must be of a very substantial character. The machine we illustrate has been designed by the firm of Bement, Miles & Company, Philadelphia, Pa., with a full knowledge of this fact, and is capable of doing the heaviest class of milling. It has a substantial bed and housings. The spindle has large bearings, adjustable for wear, and is geared eighteen times from a 24-inch cone driven by a 6-inch belt. The table is from 20 inches to 28 inches wide on the clamping surface, and is gibbed down to the bed. It traverses by hand or power, by means of a spiral pinion, which gives a perfectly smooth motion. It is also provided with a quick movement in either direction by friction pulleys. Surrounding the table is a tray which leads the lubricating fluid into a tank behind the machine. The distance between uprights is from 26 inches to 36 inches. The machine can be built so that the cross slide, which is counterweighted, will raise to any desired height above the table. There is an adjustable support for the outer end of the cutter bar, and the spindle has horizontal adjustment to suit various lengths of cutters up to the full width of the table.

The feed can be varied from one to nine inches per minute and is provided with an automatic stop motion for throwing out at any desired point. All the gearing is cut from the solid, all shafts are steel running in bronze bushings, and the workmanship on the machine is thoroughly first-class. All parts are made strong, heavy and of the best material. The various handles controlling the actions of the machine are so located that they can all be operated from the most convenient position for the operator. Two countershafts, all necessary wrenches, a pump and two tanks for circulating lubricant to the cutters, are provided with the machine.

The machine can be built of any required length. Also an additional head for vertical milling cutters can be applied to the cross-slide without destroying the arrangement of the heads for horizontal milling. The vertical head is driven from the same gearing and the application is very simple. This tool is designated by the manufacturers as their No. 6 milling machine.

Mr. Hiram S. Maxim has consented to write a series of important illustrated articles on the evolution and manufacture of automatic firing guns, the first of which appears in the current issue of *Industries and Iron.*

The Hunt Coupling for Transmission Rope.

The rapid increase in the transmission of power by rope has made prominent one of the minor difficulties attending its use. This is the gradual lengthening of the rope which increases the sag until it become necessary either to resplice the rope or to use a take-up sheave with a very long range of motion. Rapid wear of the rope from slipping on the pulleys is frequently caused by lack of sufficient tension.

The Hunt rope coupling, which we illustrate, is designed to do away with all necessity for resplicing, etc., as it will keep a rope at exactly the right tension for the most effective service and long life, and do this with little or no extra time or attention being given the matter and with no expense other than the first cost of the coupling. The device is made wholly of aluminum bronze and has a tensile breaking strength of 60,000 pounds to the square inch, and an elongation of 20 per cent. in eight inches, which is equal to the strength and toughness of mild steel. It is very simple in its construction, there being but two parts, consisting of a screw and socket. These screw together when the rope is first put on the pulleys and lock securely, so that the coupling can be separated only by using a wrench of special design.

A very important and interesting feature of the coupling when screwed together is an internal swivel and ratchet, which we show in Fig. 3. The swivel permits the joint to yield to the curvature of the pulleys while the ratchet holds the parts from revolving on each other and untwisting the rope.

The Hunt coupling is made smaller in diameter than the rope with which it is to be used, in order that it may not touch the grooves of the pulleys, even when the rope is worn.

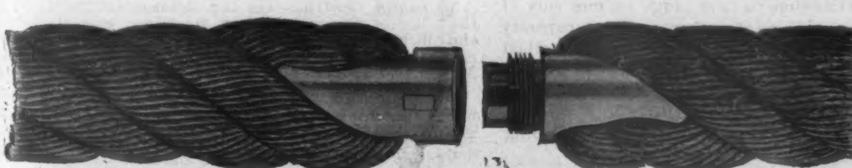


Fig. 1.

Fig. 3

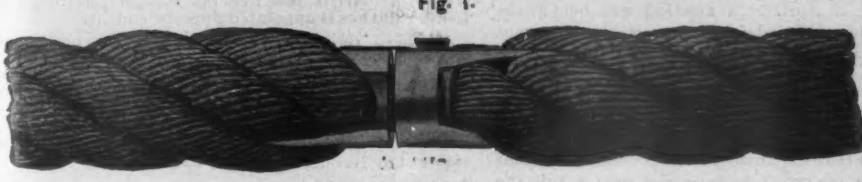


Fig. 2.

The Hunt Coupling for Transmission Rope.

The rope of the correct length for the drive, when connected up, is spliced into the coupling, and, as it wears longer, more "turns" are put into it by revolving one part of the coupling, the ratchet automatically holding all secure when the rope has the proper length and tension.

Where several independent ropes are run side by side on a pulley, all can be kept at the same tension with the greatest exactness by putting a few more turns in the slack one when such a condition is noticed. By using this coupling, in a multiple rope drive, any single rope can be taken off in a few minutes and the work done by the remaining ones until it is convenient to put on a new rope, which can be done with equal dispatch, and, what is of greater importance, the tension adjusted to correspond exactly with the other ropes. The cost of a rope drive, with this coupling spliced in and installed in position on the pulleys, is usually less than that of ropes spliced on the spot by the purchaser in the ordinary manner, and it is also less than a rope drive with a tension pulley, which, in addition to its cost, frequently requires space that is useful for other purposes. When we consider that a rope requires to be spliced two or three times during its life, while the couplings having no wear are permanent, with no further expense after once installed, it will be seen that this method is much the cheaper as well as the better one.

The advantage, both in the convenience of installation, the facility of adjustment of tension, the perfect control of the sag, and the increased life of the rope from a more equal tension, are sufficient to justify an expenditure of many times their cost.

The C. W. Hunt Company, 45 Broadway, New York City, are the exclusive licensees in the United States for the patent on this coupling, and are prepared to furnish transmission rope of the well-known "Stevedore" brand and of the usual sizes with the couplings spliced in position.

An Invitation to Strike.

Some workmen who are careless make a practice of striking the vise of a shaper upon the ends to bring it up square, using a hammer or anything else that happens to be handy, thus bruising the sliding surfaces and in a short time practically ruining the vise for efficient work. The evil effects thus produced are very plainly shown on the engraving of an old vice subjected to just such usage, which can be seen in the vise marked "Without." To prevent this, Gould & Eberhardt, the prominent machine tool builders of Newark, N. J., have been making the new and original style of vise shown above the old vise, which is furnished with all their shapers of latest design, and which does not lessen their usefulness nor reduce their capacity.

In this vise, provision is made whereby it may be tapped on the end for such fine adjustment as may be required

WITH

WITHOUT

without in the least injuring the vise in any way. To keep the matter continually before the workman, the makers have cast the word "Strike" on the vise, also arrow-points showing where to strike. It has often been asked by mechanics why the word "Strike" is cast on this vise. The reason is as explained above.

This is a machine-shop kink of much practical value and is original with Gould & Eberhardt and to be found only on shaper vises of their manufacture.

The Fox Pressed Steel Company.

For several months negotiations have been under way looking to the formation of a large concern to engage in the manufacture of Fox pressed steel trucks, as well as other forms of pressed steel which enter into the construction of railroad equipment. These negotiations have been successfully consummated, resulting in the formation of the Fox Pressed Steel Company, composed of New York and Pittsburg capitalists, whose plant will be located in Pittsburg. Ample capital has been provided, and the concern have purchased five acres of ground on the line of the Allegheny Valley Railway, near Fifty-second street, and the work of erecting the plant will be commenced at once. The contract for the erection of the buildings and also for the machinery has been let to Mackintosh, Hemphill & Co., of Pittsburg. This firm will push the work to completion as rapidly as possible, and the new concern expect to be turning out the Fox pressed steel truck about Oct. 1 next.

The plans call for a main building 450 feet long by 112 feet wide. Included in the equipment of this building are 6 power shears, 8 hydraulic presses, 2 bending machines, 11 hydraulic punches, 7 power punches, 24 hydraulic riveting machines, 16 hydraulic cranes, 5 electric cranes, and the necessary straightening tables and other smaller tools. The entire equipment will be of the most modern design. In another building, 350 by 62 feet, will be located the machine shop, blacksmith shop, pump house, boiler house and electric light plant; another and smaller building will contain the gas producers, as it is the intention to use producer gas for fuel.

The location selected for the plant is an admirable one, as the facilities for receiving and shipping material will be all that could be desired. Cars will run right into the building on a private track, and will be loaded and unloaded by overhead electric traveling cranes. The plant will be so constructed that the raw material will be received at one end, put through the various processes of manufacture and loaded on cars at the other end, thus preventing unnecessary and costly rehandling. The entire plant has been carefully designed, and when in full operation is expected to

turn out from 300 to 400 finished trucks per day, and to give employment to from 1,000 to 1,200 men.

There are now about 60,000 Fox trucks in use and the demand is constantly increasing. The material for the construction of these trucks will be principally supplied by the Carbon Steel Company of Pittsburgh, and will conform in quality with the specifications of that used by the Fox Solid Pressed Steel Company of Joliet, Ill. It is the opinion of many able and experienced railroad men that the Fox pressed steel truck frame will become the standard truck of this country, and there is no question but that where adopted, it will materially reduce the operating expenses of the road by minimizing the wear and tear of both rails and wheel flanges.

As already stated, the Fox Pressed Steel Company will manufacture all forms of pressed steel that enter into the construction of railroad equipment, in addition to the steel truck.

The American Mannesman Tube Company, of Jersey City, N. J., has been incorporated, with $3,000,000 capital. Buffalo, N. Y., is to be the principal place of business.

The patent litigation between the Consolidated Car Heating Company of Albany, and the Martin Anti-Fire Car Heater Company has been finally adjusted by the purchase of the Martin patents by the Consolidated Company.

Mr. Otto Goetze, who represents in this country the firm of Muller & Mann, manufacturers of rust proof paints and "Mannocitin," a rust preventive for bright parts of machinery, has removed his office to 114 Broad street, New York City.

The Abendroth & Root Manufacturing Company, 28 Cliff street, New York City, have just closed contracts for their Root Improved Water Tube Boiler for the electric light and power plant of the East River Bridge, Munseys new building, and the Electrical Exposition, New York City.

The New York office of the Q & C Company has been removed to Rooms 20, 21 and 22 of the 20th floor of the American Surety Building, 100 Broadway. There is nothing like being away up in the world and those who call at these offices on business or pleasure bent, will have an opportunity to see much of the world and of humanity about him.

Mr. Alex. Backus, President of the Vulcan Iron Works Company, of Toledo, O., has been made President of the Manufacturers' road, a new belt line just completed in Toledo. The first trip over the line was made March 31 and among the first cars handled was one switched to the Vulcan Iron Works to load a monster Vulcan shovel, which, with three others, is destined for the Mesabi Range.

The Schoen Pressed Steel Company, recently organized in Pittsburg with a capital stock of $1,000,000, have purchased the plant of the Schoen Manufacturing Company, also all of the patents relating to the manufacture of pressed steel specialties owned by the latter concern, including the patents for the manufacture of pressed steel truck frames owned by Charles T. Schoen; this truck frame was illustrated by us last month. The Schoen Pressed Steel Company have bought 5¾ acres of land adjoining the present plant of the Schoen Machine Company, in Allegheny. The capacity of the present plant is 125 truck frames per day, but when the additions to equipment and buildings now under way have been completed this will be increased to 300 sets per day. There is also being turned out at present about 75 tons per day of pressed steel car bolsters and other patented specialties. This tonnage will probably be doubled.

The Westinghouse Electric Company has issued a call for a special meeting of its stockholders, to be held on June 4, to vote on a proposition to increase its capital to $15,000,000. The present authorized capital is $10,000,000, of which a little more than $9,300,000 has been issued. The object of the increase is stated to be for the purpose of wiping out existing floating debts and providing additional capital for the increase in business which is expected the coming year, and which will be one of the results of the recent agreement entered into with the General Electric Company. It is said that the increase will be authorized because a number of large stockholders who had been consulted before the call was issued have indorsed the proposition. It is said that $3,000,000 of the proposed increase has already been disposed of, but the stock will not be issued until formal action is taken at the stockholders' meeting.

The Stilwell-Bierce & Smith-Vaile Company, of Dayton, Ohio, have taken the contract for a complete water power plant to be installed at the Lachine Rapids in the St. Lawrence River. This power is said to be second only to Niagara Falls in importance, and is owned by the Lachine Rapids Hydraulic and Land Company, Limited, of Montreal, Canada. It is located at the famous Lachine Rapids on the St. Lawrence River, about five miles above Montreal. The initial development will amount to 10,000 horse-power. The work of construction has already begun, and the company expect to be prepared to furnish power before the close of this year. They have contracted with the Stilwell-Bierce & Smith-Vaile Company for 66 largest size Victor turbines of the latest pattern, and all machinery needed for transmitting the power of these turbines to the electric generators. This is probably the largest order for such equipment ever placed at one time.—*Iron Age.*

The firm of Bruner, Sprague & Company, 1005 Chamber of Commerce Building, Chicago, Ill., are the sole selling agents for the Sall Mountain Asbestos Company. This company has an immense mine of pure short fiber asbestos, located at Sautee, White County, Ga., and is prepared to furnish it at prices so low that it can be used in direct competition with mineral wool and kindred materials; at the same time it is claimed to be far superior to those materials in quality and durability and goes much farther, pound for pound. It is being used by architects and builders for fireproofing, insulating partitions, and deadening floors; by car builders for insulating refrigerator cars and for deadening material in the floors of coaches and sleeping cars; and by locomotive builders and railroads for lagging locomotives and covering steam pipes and boilers. Among the roads using it for boiler lagging are the Chicago & Northwestern and the Chicago and Eastern Illinois roads.

During the past month we received a copy of a formidable looking injunction, which on closer inspection proved to have come from the American Blower Company, of Detroit, and purported to enjoin competitors from claiming to have the "best blowers," while the American Blower Company's "A B C" hot-blast heater is in the market. Appended is a description of the heater. Ordinarily the steam pipes in the heaters of hot blast apparatus are in the form of an inverted letter U, with the ends connected to a cast-iron base. Each series of pipes is placed within the area enclosed by the next larger one, until all the space is occupied. The outside pipe is thus several times longer than the inner or shortest one, and this difference in length is held to cause marked difference in the circulation of the steam, so that some of the heating surface is inefficient. In the "A B C" heater the inner lines of pipe are given convolutions so as to make all pipes of practically the same length, and thus avoid "short circuiting" of the steam. Furthermore, the base is made in two sections, and so designed as to prevent air pockets. The valves and fittings are all at one side of the base for convenience in connecting to them. The company will be pleased to furnish additional information to those interested.

At Rice's Point, opposite the entrance of the harbor at Duluth, Minn., is a coal dock of great size owned by the Ohio Coal Company, which has recently been newly equipped throughout with the most improved appliances for handling coal. The dock is 1,560 feet long and 300 feet wide, a double railway track extending through its center. It has a shed 950 by 150 feet, with watertight roof, for housing all the anthracite coal received, and the daily unloading capacity is 4,000 tons, the coal being handled by the Newell & Ladd self-filling or clam-shell buckets, made specially heavy for digging soft lump coal, while the carriages by which the loaded buckets are conveyed from the dock front to the pockets in the center—150 feet—or dumped at any intermediate point, were made by W. S. Boyle & Company, of Chicago. There are ten 60-horse-power Mundy engines and five 100-horse-power boilers, anthracite dust being used as fuel and steam being furnished to the movable towers along each side of the dock by an 8-inch pipe, 3,500 feet long, provided with 125 openings, permitting the making of connection with the main pipe at almost any point where it is necessary to place the hoisting rig. The whole equipment is deemed especially advantageous for the handling of big lump coal, which has heretofore been done by hand labor only.—*Scientific American.*

At the shops of Beaman & Smith, Providence, R. I., a large horizontal boring mill has just been completed for an electrical concern, and is to be used principally in boring out the fields of dynamos. It has an 8-inch spindle and will bore a hole 5 feet in diameter. The spindle can be adjusted to any required height, up to 6 feet from its center to the plates. The maximum distance between housings is 14 feet, and the platen is 8 feet by 19 feet. The gearing, and for that matter all the other parts, are of the best. The spindle passes through bearings that are lined with a thin conical sleeve or bushing of brass or bronze, which by adjustment longitudinally is compressed in the direction of its diameter, so as to compensate for wear of the spindle. The bushings are solid, not split. Another interesting special tool under construction at these shops is a machine for making plug cocks for a pipe line concern. It operates at one time on four plugs on one side of the machine and four shells on the other, and has a capacity of about 8,000 per month. One notable feature of the method of finishing the shells is the fact that no reamer is used to finish the tape hole for the plug. It has been demonstrated by the superintendent of the pipe line, that the work can be done more cheaply and with equal accuracy by finishing the hole with ordinary boring tools.

On the evening of April 16, a meeting was held at the Manufacturers' Club in Philadelphia, to celebrate an event that was not only a source of pleasure to those present but a genuine gratification to the many friends of Queen & Company of that city. Nearly two years ago that well-known firm assigned to Mr. J. G. Gray, with assets valued at $460,000 and liabilities aggregating about $184,000. The confidence of the creditors was such that the business was continued without interruption. Now the creditors have been paid in full, the receivership at an end, and the business placed in the company's hands with no liabilities and assets of more than $200,000. The gathering at the Manufacturers' Club was to celebrate this event. Mr. Gray was presented by the creditors with a magnificent set of the Encyclopedia Brittanica, for his skillful management of the business, the several addresses contained much praise for both Mr. Gray and Queen & Company. The house of Queen & Company was established in 1853 by James W. Queen, who had previously been a member of the firm of McAllister & Company. He had made the original firm a scientific center, and on establishing the new house he naturally carried with him the scientific connections which he had formed. He was known to all the scientific men of his day, and they delighted to visit his establishment. Mr. Queen instituted the greatly reduced weight in spectacles, as they are now made. He imported the first forms for grinding spectacle glasses that were used in the United States. He made the first kaleidoscope, the first magic lantern, stereopticon, stereoscope, microscope and platina points for lightning rods. In 1858, failing health lead him to seek a partner in the business and he invited Mr. Samuel L. Fox, who had been a lad under him at the old establishment, and was then 24 years of age, to join him as an equal partner. The firm's name then became James W. Queen & Company. In 1870 Mr. Queen retired from business, selling his interest to Mr. Fox, who continued the firm name of James W. Queen & Company, until the year 1893, when the stock corporation of Queen & Company was formed. The assignment which the company was obliged to make in 1894 was due to the expansions, made in good judgment by it, in the manufacturing and store plants in 1892, to meet the increasing demand for scientific instruments and to the business depression which took place in 1893 over the whole world.

John C. Gray, the assignee of the company, has been connected with James W. Queen & Company and Queen & Company since 1882. In the reorganization of the company Mr. Gray assumes the Presidency. Mr. S. L. Fox is Vice-President, and Mr. J. M. Hazel, Secretary and Treasurer.

Our Directory

OF OFFICIAL CHANGES IN APRIL.

We note the following changes of officers since our last issue. Information relative to such changes is solicited.

Adirondac & St. Lawrence.—Charles H. Burnett has been appointed Purchasing Agent with office at 51 East 44th Street, New York City.

Altoona & Philipsburgh Connecting.—Mr. Henry Levis has been elected President to succeed S. P. Langdon.

Atlantic and Pacific.—C. W. Smith is Receiver and General Manager, with office at Albuquerque, N. M.

Boston & Albany.—Mr. Thomas B. Purves, Jr., has been appointed Superintendent of Rolling Stock, and will have charge of both the locomotive and car departments, with office at Springfield, Mass.

Mr. William H. Taft, now Acting Superintendent of Motive Power, has been appointed Superintendent of Motive Power, with office in Boston.

Mr. C. H. Barnes has been appointed Division Master Mechanic at West Springfield, Mass.

Central Vermont.—Messrs. Charles M. Hays, General Manager of the Grand Trunk, and Edward C. Smith, President of the Central Vermont, were on March 20 appointed Receivers.

Cleveland, Akron & Columbus.—Mr. B. F. Marshall has been appointed Master Mechanic, with headquarters at Mount Vernon, O., to succeed Mr. W. J. Vance, resigned.

Drummond County.—Mr. C. Church has resigned as president.

Eastern Railway of Minnesota.—Mr. Howard James has been appointed Purchasing Agent, with headquarters at Duluth, Minn.

Grand Trunk.—Mr. Hebert Wallis has resigned the position of Mechanical Superintendent, and Mr. F. W. Morse has been appointed his successor.

Gulf & Interstate.—Mr. W. A. Meagher has been appointed Master Mechanic, with headquarters at Galveston, Tex.

Interoceanic of Mexico.—Mr. G. M. Stewart has been appointed General Manager, with headquarters at the City of Mexico.

Los Angeles Terminal Railway.—Mr. T. E. Gibbon has been appointed Vice-President, and Mr. Wm. Wincup Acting General Manager in charge of traffic and operation, vice T. B. Burnett.

Louisville, Evansville & St. Louis.—Mr. G. F. Jarvis appointment as the sole receiver of the Louisville, Evansville & St. Louis road, to succeed Receivers Hopkins and Wilson, takes effect May 1.

Macon & Birmingham.—Mr. Julian R. Lane has been appointed General Manager.

Macon & Northern.—Mr. Edgar A. Ross has been appointed Receiver in place of Mr. William H. Ross.

Mexican Railway.—Mr. E. G. Evens has resigned as Locomotive Superintendent and Mr. Alfred Atwood has been appointed to succeed him with headquarters at Apizaco, Mexico.

Michigan Central.—On the decease of Mr. C. E. Smart the office of General Master Mechanic was abolished and the office of Superintendent of Motive Power and Equipment created. Mr. Robert Miller is appointed to the position, and Mr. R. H. L'Hommedieu becomes General Superintendent.

Middle & East Tennessee Central.—Mr. W. W. Fidler has been appointed General Manager, with office at Hartsville, Tenn.

Norfolk & Ocean View.—The office of General Manager has been abolished and that of Superintendent created. Mr. W. A. Barritt, late General Manager, retires, and Mr. Lee D. Mathes is appointed Superintendent.

Northern Ohio.—Mr. John T. Clark has been appointed Master Mechanic with headquarters at Delphos, Ohio.

Ohio Southern.—N. E. Matthews has been appointed Purchasing Agent, with office at Springfield, O., vice C. H. Roser.

Oregon Central & Eastern.—Offices of Master Mechanic and Master Car Builder have been abolished.

Pittsburgh, Lisbon & Western.—C. H. Smith will be General Manager of this road, which is the reorganized Pittsburgh, Marion & Chicago.

Southern.—Third Vice-President W. W. Finley has resigned.

St. Louis, Chicago & St. Paul.—Mr. Henry W. Gays has been made General Manager. General Superintendent L. W. Fowler has resigned and the office has been abolished.

Wabash.—Mr. F. W. Morse has resigned the position of Division Master Mechanic at Fort Wayne.

Employment.

WANTED.—A Superintendent for a small car works. Active, practical and thoroughly up in car building. Address, with references, THE RATHBURN COMPANY, Deseronto, Ont., Canada.

A GRADUATE ENGINEER, of eight years' experience in a special line of railroad supplies, having a large acquaintance among railroad men, and car builders, desires a position where such knowledge and experience will be of value. Address, W. C. S., Room 36, No. 2 Exchange Court, N. Y. City.

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